TECHNOLOGY DEPT.

THE INSTITUTE OF PETROLEUM REVIEW

V 9 #102

Fourth World Petroleum Congress Issue.

PUBLIC LIBRARY
MAY 23 1955
DETROIT

ONE SHILLING AND SIXPENCE

Published by The Institute of Petroleum
26 Portland Place, London, W.1

DESIGN PROCUREMENT

CONSTRUCTION COMMISSIONING

A Section of One of our Design Offices.

THE

MATTHEW HALL

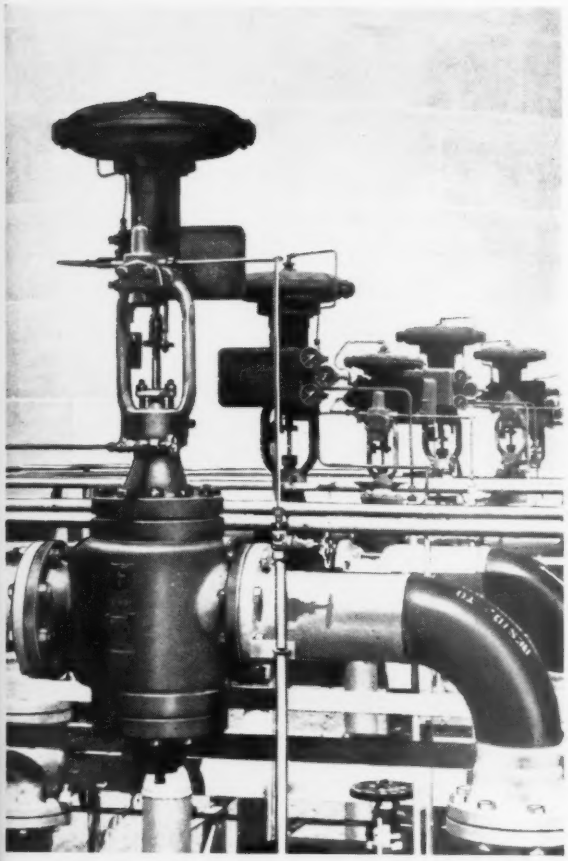
GROUP OF COMPANIES

OIL REFINERY ENGINEERS

MATTHEW HALL HOUSE, DORSET SQUARE, LONDON, N.W.1.

Manchester Glasgow Bristol Johannesburg Germiston Durban Cape Town Welkom Belfast Dublin West Indies Bulawayo

FISHER
EQUIPMENT AT THE
Aden Refinery



Fisher Control Valves at No. 3 Pump House (Oil Blending) at Aden. 330 of these valves are installed throughout the new 5,000,000 tons a year refinery. Photograph by courtesy of The British Petroleum Co. Ltd.

Fisher, the world's leading manufacturers of control valves, offer the most versatile and complete range of Diaphragm Motor Valves, Pressure Regulators and Level Control Equipment for the Petroleum Industry. They are built to specific requirements to meet the most rigorous pressure, temperature and corrosion service conditions.

Write for full information

FISHER GOVERNOR COMPANY LIMITED

CENTURY WORKS, LONDON, S.E.13. Telephone: TIDEWAY 3232

THE INSTITUTE OF PETROLEUM

REVIEW

Hon. Editor: E. B. EVANS, M.Sc., PH.D., F.R.I.C.

Hon. Associate Editor: D. L. SAMUEL, B.Sc., A.R.I.C.

Editor: GEORGE SELL

Vol. 9, No. 102 **June 1955**

Contents

A MESSAGE FROM THE PRESIDENT OF THE INSTITUTE OF PETROLEUM 121

THE WORLD PETROLEUM CONGRESS 123
By *T. Dewhurst*

THE ITALIAN PETROLEUM INDUSTRY 125
By *G. Cozzi*

THE INSTITUTE OF PETROLEUM 129
By *G. Sell*

AROUND THE BRANCHES 132

THE EMPIRE THAT WAS ROME 133
By *D. A. Hough*

THE VISITOR IN ROME 136

THE TECHNICAL SESSIONS OF THE FOURTH WORLD PETROLEUM CONGRESS:
SECTIONS I TO III 139
SECTIONS IV TO IX 148

PERSONALITIES OF THE CONGRESS: PHOTOGRAPHS AND BIOGRAPHIES 144

PERSONAL NOTES 156

THE OUTLOOK FOR THE OIL INDUSTRY 157
By *G. P. Glass*

BOOKS AND FILMS 161

RECENT DEVELOPMENTS IN DIESEL ENGINE RESEARCH . 162
By *Prof. F. Morton*

NOTES OF THE MONTH 167

Price 1/6 Annual Subscription 15/-, post free

Published monthly by

THE INSTITUTE OF PETROLEUM

26 Portland Place, London, W.1

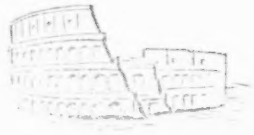
'Phone: LANgham 2250

Printed by
Richmond Hill Printing Works Ltd., Bournemouth

WORLD PETROLEUM CONGRESS

ROMA

JUNE 6-15, 1955



WHEN IN ROME

you are cordially invited to view the new full-color motion picture

"THE ORTHOFLOW FLUID CATALYTIC CRACKER"

in the

MIRROR ROOM, HOTEL EXCELSIOR

The narration will be in French and English, the official languages of the Congress. For your convenience, there will be several showings daily. There will also be a photographic exhibit of the world's newest refinery construction.

DURANT VOTRE SEJOUR A ROME

vous êtes cordialement invité à la présentation du nouveau film en couleurs

"THE ORTHOFLOW FLUID CATALYTIC CRACKER"

dans la

SALLE DES MIROIRS, HOTEL EXCELSIOR

Un commentaire sera fait en francais et en anglais, les deux langues officielles de l'Assemblée. Pour plus de commodité, plusieurs séances par jour seront organisées à votre intention. Vous pourrez en outre visiter une exposition de photographies montrant certains des types d'installation les plus récents parmi les raffineries de pétrole internationales.

AL ESTAR EN ROMA

se le invita cordialmente a la exhibición de la nueva película cinematográfica en colores

"THE ORTHOFLOW FLUID CATALYTIC CRACKER"

en el

SALON DE LOS ESPEJOS DEL HOTEL EXCELSIOR

La narración de la película se hará en inglés y francés—idiomas oficiales del Congress—y para mayor comodidad de usted se efecturán varias proyecciones al dia. También se exhibirán fotografías de varias de las más modernas refinerías del mundo.

DURANTE IL VS/ SOGGIORNO A ROMA

siete cordialmente invitati ad assistere alla presentazione della nvova pellicola a colori

"THE ORTHOFLOW FLUID CATALYTIC CRACKER"

nella

SALA DEGLI SPECCHI DELL'HOTEL EXCELSIOR

Il parlato sarà in Francese e in Inglese, le lingue ufficiali del Congresso. Par Vs/convenienza Vi saranno diversi spettacoli giornalieri. Vi sarà inoltre una mostra fotografica della piu recenti costruzioni di reffinerie nel mondo.

KELLOGG

THE M. W. KELLOGG COMPANY, NEW YORK 7, N. Y.
KELLOGG INTERNATIONAL CORPORATION, LONDON, W. I.
KELLOGG PAN AMERICAN CORPORATION, NEW YORK 7, N. Y.
THE CANADIAN KELLOGG COMPANY LIMITED, TORONTO
Subsidiaries of Pullman Incorporated

For individual film showings later, please write Kellogg International Corporation, Kellogg House, Chandos Street, London, W.I.

PARAMINS

mean better lubricants

Paramins are solving lubrication problems in a variety of ways. **Paratone** improves cold starting. The **Paranox** series provide maximum detergency with balanced oxidation and corrosion inhibition. **Paraflow** reduces pour points.

These well-tried additives, developed in one of the world's largest petroleum research laboratories will enable *your* lubricants to meet the exacting demands of modern machinery. Why not arrange for our representative to call?

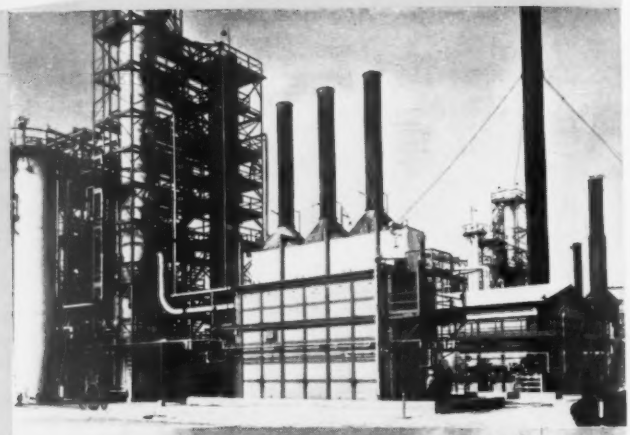
PARAMINS
TRADE MARK

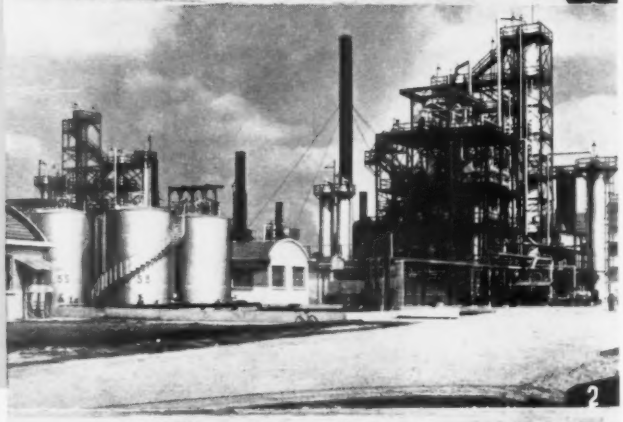
Paraflow Pour Point Depressant, Paratone Viscosity Index Improver, Paranox Range of Detergent Inhibitors, Paratac Stringiness Agent, Vistone B Oiliness Agent, Paradyne Fuel Improvers.

ESSO PETROLEUM COMPANY, LIMITED, 36 QUEEN ANNE'S GATE, LONDON, S.W.1

CRAIG

Were the main Contractors– responsible for Purchasing, Construction and operation of the I.C.I.P. Refinery at Mantova, Italy


1


2

3

1 Crude distillation unit showing up draught furnace, salt settler, fractionating column and structure carrying strippers, condensers, coolers and heat exchangers.

2 General view of crude, visbreaking, desulphurising, recovery and stabilisation units.

3 General view of Refinery with Mantova in background.

4 Tank farm showing in foreground the pontoon floating roof tanks for crude oil.

5 Graphic type panels are installed on both sides of control room with operator desk panels in centre. Crude and visbreaker unit panel is illustrated.

6 Over-head steam, water, oil and gas lines substantially supported and conveniently located for distribution between the units.

4

5

6

The Refinery was designed by the Koch Engineering Company, Wichita, Kansas, U.S.A.

A. F. CRAIG & COMPANY LIMITED

Caledonia Engineering Works, **PAISLEY, SCOTLAND**

London Office: 727 Salisbury House, London Wall, E.C.2. Tel: National 3964

S·W·
FARMER
& SON LIMITED

EST. 1898

FABRICATORS IN STEEL

For the Oil Industry

S.W. FARMER & SON LTD, COURTHILL ROAD, LEWISHAM, LONDON, S.E.13.
'PHONE: LEE GREEN 4334-9.

Fürst

ITALIAN PRECIOUS JEWELRY

Rome

VIA S. NICOLO DA TOLENTINO 9
(corner Via Bissolati)

Turin

VIA ROMA 330

MODERN
PETROLEUM
TECHNOLOGY

SECOND (1954) EDITION

702 pages 200 Illustrations

Price 35s. 0d. post free

Obtainable from

The Institute of Petroleum
26 Portland Place, London, W.1

Mr Truck Buyer

HAVE YOU AN

EXPORT PROBLEM?

Built on the famous Thames 'Sussex' chassis, this 1,450 gallon Kerosene Tanker body built by W. B. Bawn Ltd. conforms to all Export requirements and is available through

FORD MOTOR COMPANY LIMITED.

IF SO WE CAN HELP YOU

Write or 'phone

EXPORT DIVISION

FORD MOTOR COMPANY LIMITED
DAGENHAM · ESSEX

RAINHAM 3000 extension 45

STRUCTURES IN STEEL

We Specialise in
ALL TYPES OF STRUCTURES
Required for
Oil Production and Refining

ALSO
'KELVIN' *all iron* and 'MAINSTEEL' PALISADING
and All Types of FENCING
for HOME and OVERSEAS

A. & J. MAIN & COMPANY LIMITED

LONDON OFFICE
VINCENT HOUSE, VINCENT SQUARE, S.W.1
Telephones: Victoria 8375/6/7/8 *Telegrams:* Kelvin Sowest, London

WORKS AND REGISTERED OFFICE
CLYDESDALE IRONWORKS, POSSILPARK GLASGOW, C.2
Telephone: Possil 8381 *Telegrams:* Kelvin, Glasgow

CALCUTTA: Post Box 36, 16 NETAJI SUBHAS ROAD
also NAIROBI and CHITTAGONG

Price of Shield, including postage: 26/10d. Size: 7″×6″

Catalogues sent on request

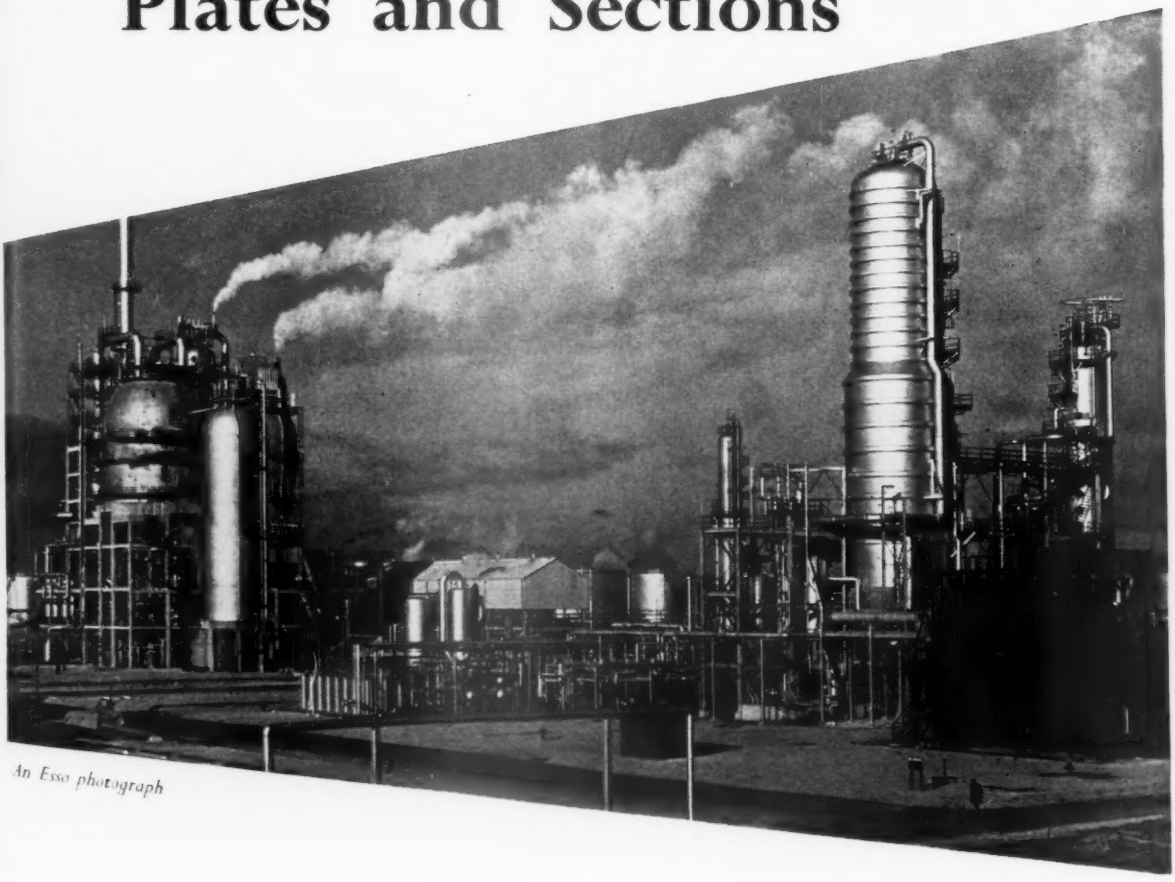
PIGGOTT BROTHERS & COMPANY LIMITED

- *Makers of Tropical Kit and Equipment*
- *And all classes of Canvas Goods*

SUPPLIERS OF THE INSTITUTE CREST, AND ALL OTHER SCHOOL, REGIMENTAL AND COLLEGE COATS OF ARMS

220-226, BISHOPSGATE, LONDON, E.C.2.

APPLEBY-FRODINGHAM
Plates and Sections



An Esso photograph

Appleby-Frodingham Steel Plates and Sections have played a great part in the construction of recent large plants for the production of petroleum and chemical products. Special 'welding quality' Appleby Plates are used in the fabrication of tanks, process equipment and pressure vessels.

THE UNITED STEEL COMPANIES LTD

APPLEBY-FRODINGHAM STEEL COMPANY

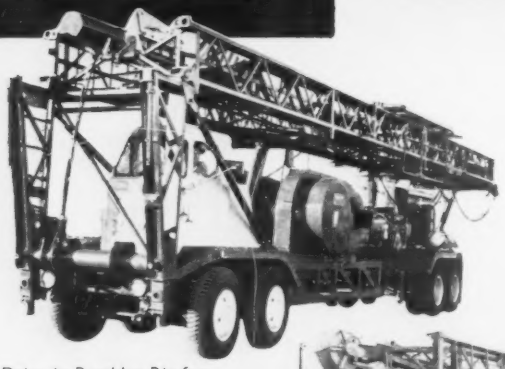
SCUNTHORPE *Branch of The United Steel Companies Limited* LINCS.

Telephone: Scunthorpe 3411 (12 Lines) *Telegrams: 'Appfrod' Scunthorpe*

AF126

IDECO
WOODFIELD

Makers of drilling and production equipment in association under licence with IDECO division of Dresser Equipment Company, U.S.A.

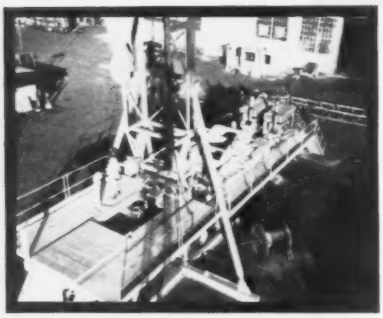


Drive-in Rambler Rig for servicing, workover and light drilling

W4A Servicing Rig for operating with or without Mobile Mast

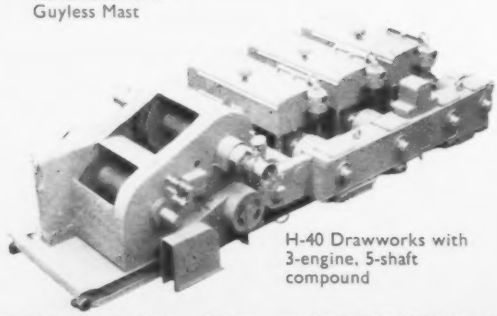
H-20 Rig with KM-65-100-C Mast

133 feet Full-View Drilling Mast



Dual trailer mounted Drilling Rig with Kwik-Lever-Lift Guyless Mast

W7 Mk II Servicing Rig on Scammel 6 x 6 "Constructor" Vehicle jointed to leave mast at location



H-40 Drawworks with 3-engine, 5-shaft compound

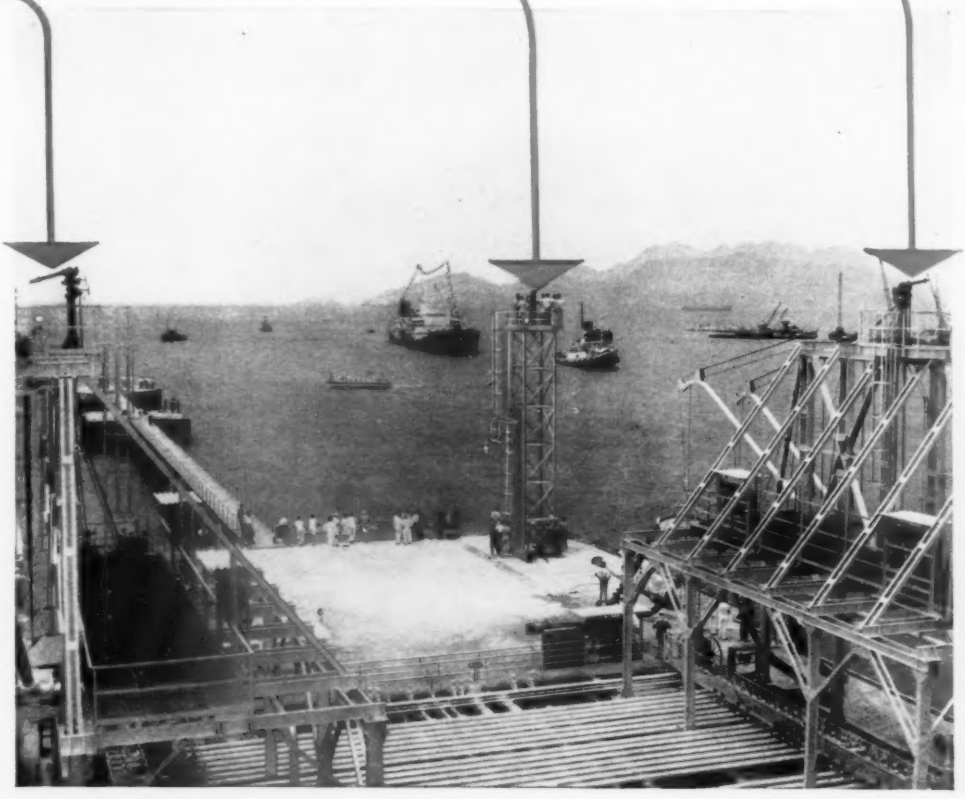
WOODFIELD HOIST AND ASSOCIATED INDUSTRIES LTD · ROCHESTER · ENGLAND

Telephone: Strood 7642/3 — Telegrams: Woodfield, Rochester

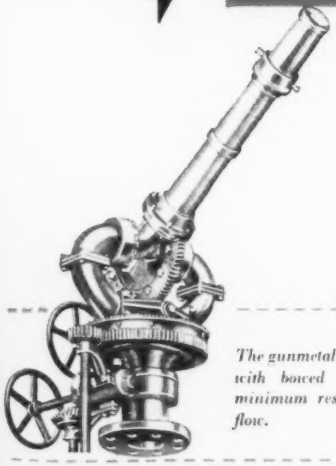
Incorporating the

KEMWORTHY JIG & PRESS TOOL COMPANY, LONDON

GUARDING THE OIL HARBOUR AT ADEN



Foamite JETTY MONITORS



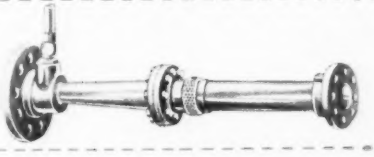
Standing fire guard along the jetty at Aden are the familiar Foamite Foam Monitors mounted on steel towers. Altogether there are 12 of these monitors in this installation spaced at strategic intervals. Three can be seen in the photograph taken on the occasion of the arrival of the first tanker in the harbour.

The monitors point in any direction—elevation and rotation are controlled either at the monitor itself or from ground level—and in the event of fire, they instantly discharge a powerful jet of foam on to the affected area blanketing the outbreak and extinguishing the fire before it has a chance to get a hold.

Photograph by courtesy of The British Petroleum Co. Ltd.

The gunmetal monitor is 4" size with bowed shoulders giving minimum resistance to liquid flow.

Pressure Foam Maker comprising Proportioner (mixing water and air foam liquid) and Aspirator (aerating the mixture)



FOAMITE LIMITED

235-241 REGENT STREET, LONDON, W.1. • TELEPHONE REGENT 6537/8

F3

Failing Portable Well Drilling Outfits

Manufactured by Mitchell Engineering Ltd., Peterborough, England, under licence from George E. Failing Company, Enid

TYPE M.2

TRUCK MOUNTED

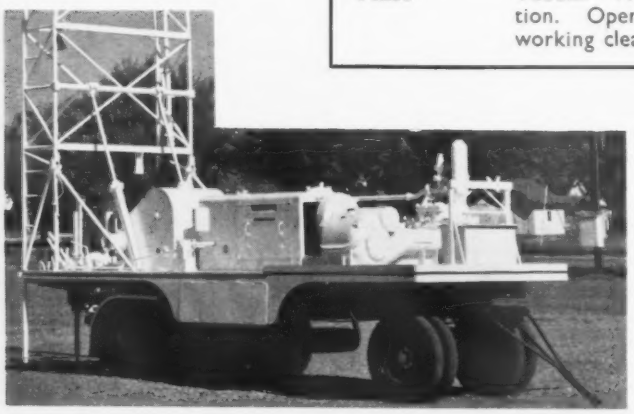
LEYLAND COMET TRUCK WITH 350 DIESEL ENGINE

Transport	Thro' 5 Forward 1 Reverse Gear Box and 2-speed Rear Axle.
Drilling	From Full Load Power "Take-off" to 4 Forward 1 Reverse Auxiliary Gear Box.
Tyres	9.00 × 20 Twin on Rear and Single on Front.
Brakes	Vacuum System.

Other details as on Type M.1

ALL UNITS FITTED WITH ISOLATING CLUTCHES

Capacity	
Depth	1000 ft with 3½ drill pipe. 1650 ft with 2⅞ drill pipe. 2500 ft with 2⅜ drill pipe.
Hole diam.	24 inches to 4¾ inches.
Hydraulic Operations	Mast Elevation and Lowering. Drill String Feed. Drill Pipe "Make and Break". Drill Head Retraction.
Pump	200 galls (US) per min. 500 lbs working pressure.
Drawworks	Hoisting Drum and Sand Reel.
Travelling Block	2-sheave spring loaded with combined Twin Hook for Elevators.
Swivel	"Tear Drop" Type 2" with Shank for Elevators.
Kelly	3⅜ diam × 26 ft long.
Mast	Tubular Welded Construction. Open Front. 40 ft. working clearance.



TYPE M.1

TRAILER MOUNTED

Trailer	Six Wheel. Double Rear Axle.
Trailer Brakes	Air or Vacuum as required.
Tyres	7.50 × 20 Twin.
Engine	Leyland 6 cyl. Diesel 350 with 5 Forward 1 Reverse, with Front End Power "Take-off" for Pump Drive. Mounted on Deck.
Pump	6 × 6 Duplex power type with 8 individual Valve Pots; Renewable Liners, Valves, Pistons and Piston Rods.
Drawworks	2-Reel pattern with free running drums and interchangeable Brake Bands. Chain Driven. Individual Clutch for each reel

Cables:
Failingrig, London

FAILING SUPPLY LIMITED

ONE, BEDFORD SQUARE

LONDON WC1

Phones:
EUSton 8364
EUSton 1186
MUSeum 5511

New York:
45 Rockefeller Plaza

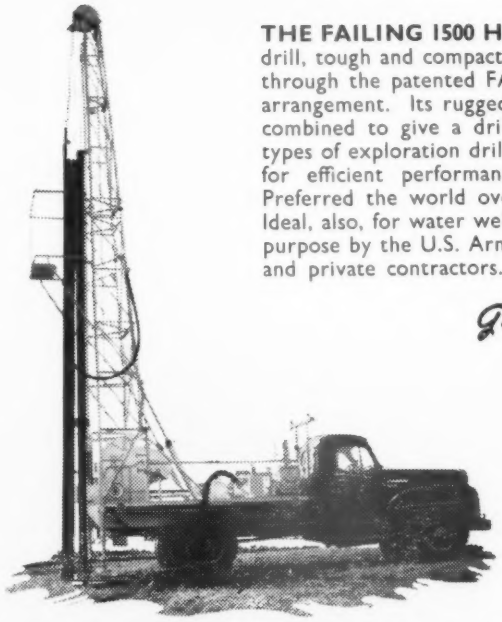
Paris:
Lindqvist et Cie, 10 Rue Auber

World-over . . . wherever you go . . .

FAILING RIGS ARE ON THE JOB!

THE FAILING 2500 HOLEMASTER rig, leader in its field, is built for deep water well drilling, shallow oil production drilling, and exploration drilling to 5500 feet. Outstanding features include streamlined design; relatively light weight; sturdy construction; balanced crown block; sectional mast; double-drum, air-operated hoist; and dual engines coupled through a special hydraulic cushion drive. The mud pump, $5\frac{1}{2} \times 8$, is unitized with the drill. Finger-tip air controls are grouped for ease of operation.

FAILING RIGS are . . .
Worth More New . . .
Worth More Used!



THE FAILING 1500 HOLEMASTER rig is a real all-purpose drill, tough and compact. It is powered from the truck engine through the patented FAILING Power Take-off and Sub Drive arrangement. Its rugged construction and medium weight are combined to give a drill of extreme versatility. Handles all types of exploration drilling to 1500 feet, yet it is light enough for efficient performance in seismograph shot hole work. Preferred the world over by oil men who know their drills. Ideal, also, for water well drilling, and extensively used for this purpose by the U.S. Armed Forces, many foreign governments and private contractors.

George E. Failing Company
A SUBSIDIARY OF WESTINGHOUSE AIR BRAKE COMPANY
ENID, OKLAHOMA, U.S.A.

GEORGE E. FAILING COMPANY ®
"Cores Will Tell"

EXPORT OFFICE : 45 Rockefeller Plaza, New York 20. U.S.A.
LONDON OFFICE : Failing Supply Ltd., 1 Bedford Square, London, W.C.1, England.
PARIS OFFICE : Lindqvist et Cie, 10 Rue Auber, Paris IX, France.

* PERRAULT
pipeline equipment

Perrault equipment is known — and preferred — the world over. Contractors everywhere have discovered that the dependability of Perrault machines and service just can't be beat. And they know that they can call Perrault Equipment Company for everything they need . . . and can get it at competitive prices. We'd like YOU for a satisfied customer, too. Call Perrault Equipment before figuring on your next job.

Everything
FOR THE PIPELINER

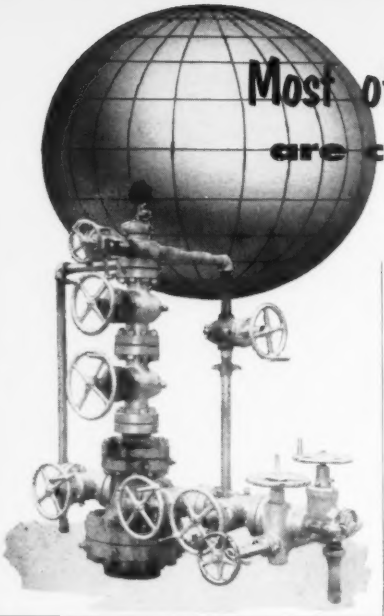
● Line Traveling and Stationary Coating and Wrapping Machines, Cleaning and Priming Machines ● Perrault-American Tar-Heating Kettles, Patch-pots, Burners, parts and accessories ● H & L Digging Teeth ● Pipe Protection Materials — Kraft, Asbestos Felt, Glass Wrap and Rock Shield ● General Supplies — Hooks, Blocks, Line-up Clamps, Sling Belts, Cradles, Hand Tools, materials, supplies and equipment of every sort - - - Everything for the Pipeliner.

PERRAULT *Equipment* **COMPANY**
W. O. DIXON, SOLE OWNER

PARIS OFFICE: LINDQVIST ET CIE, 10 RUE AUBER, PARIS IX

EXPORT OFFICE: SUITE 1655, 45 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Most of the World's High Pressure Wells
are controlled by W-K-M Valves



U.S.A.

France

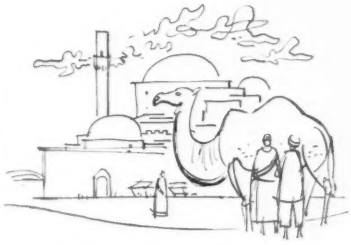
Italy

Venezuela

Argentina

Mexico

Bolivia



Kuwait

W·K·M Valves

Export Office:

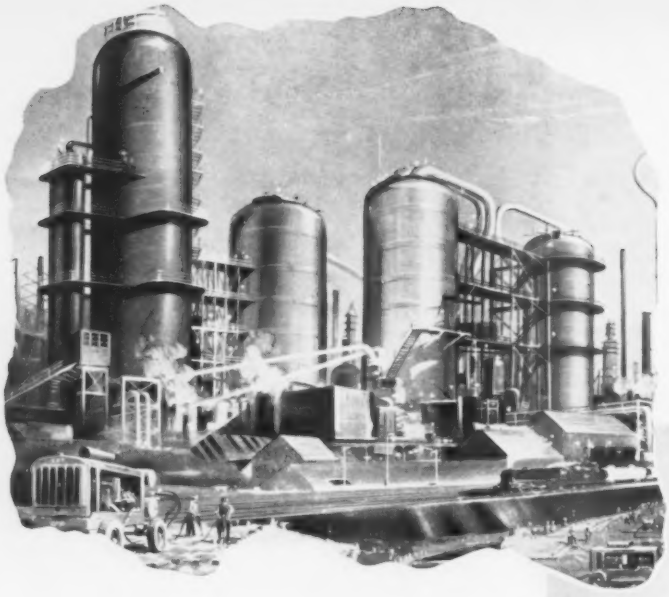
45 Rockefeller Plaza
New York 20, U.S.A.

London Office:

W-K-M Valve Co. (Britain) Ltd.
Canberra House,
313 Regent Street, London W. 1

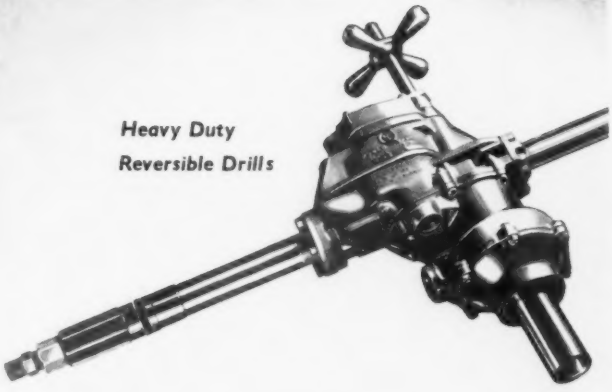
Paris Office:

Lindqvist et Cie,
10 Rue Auber, Paris IX



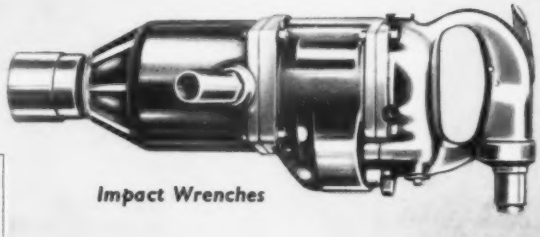
TOOLS FOR REFINERY MAINTENANCE

Boyer Long-Stroke Riveting Hammers



Heavy Duty Reversible Drills

Steelclad Grinders



Impact Wrenches

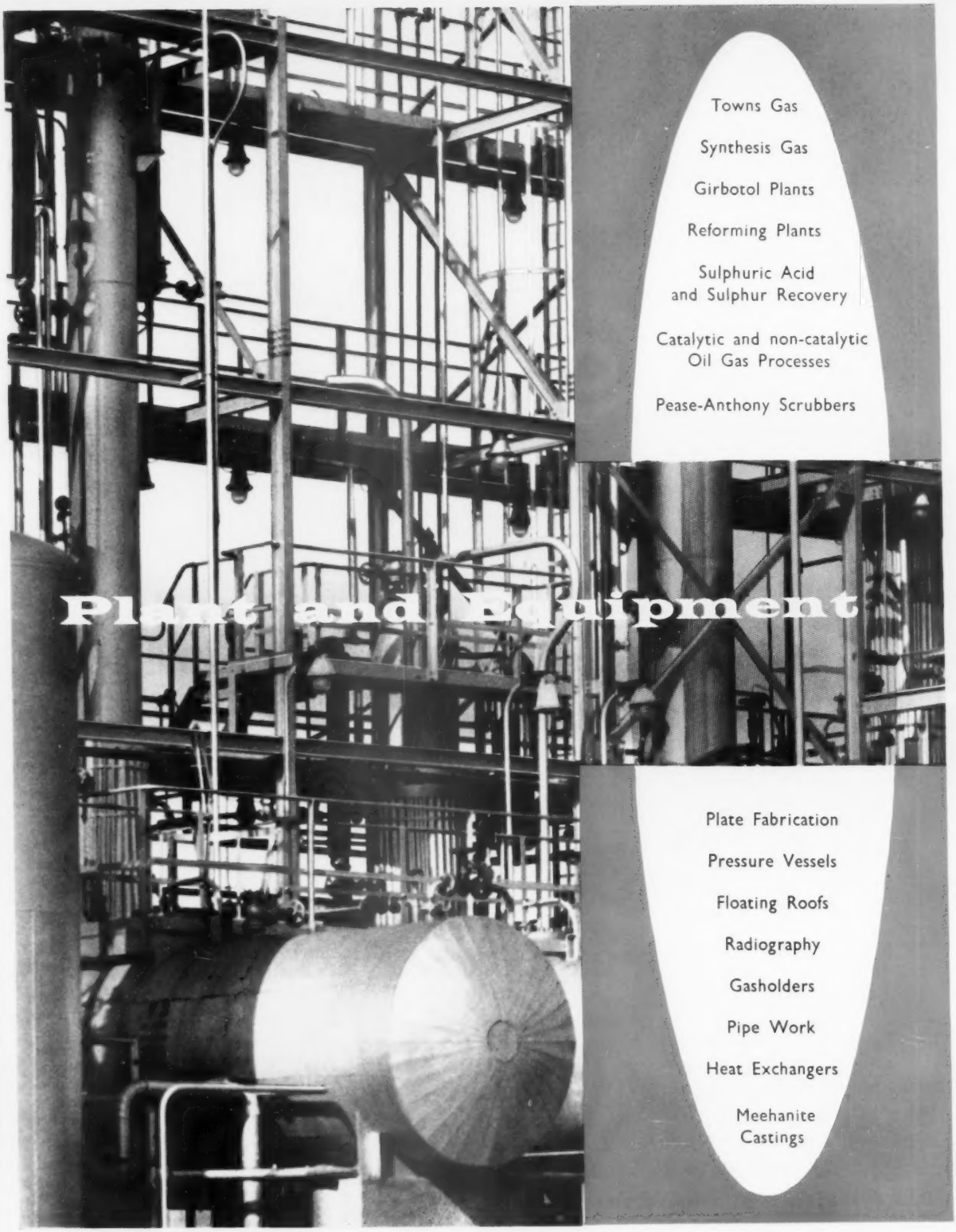
EVERYTHING that a refinery needs in the way of power tools is provided in the vast C.P. range. Reliability and efficiency are outstanding in these specialised tools, and with such a comprehensive range every aspect of refinery maintenance can be covered with the assurance that the most economical use is being made of compressed air power.

Consolidated Pneumatic

MAKERS OF *high-class* ROCK DRILLS, AIR COMPRESSORS AND POWER TOOLS

CP32

THE CONSOLIDATED PNEUMATIC TOOL CO. LTD., 232 DAWES ROAD, LONDON, S.W.6



THE POWER-GAS CORPORATION LIMITED

AND

ASHMORE, BENSON, PEASE & COMPANY

STOCKTON-ON-TEES AND LONDON

AUSTRALIA · CANADA · INDIA · FRANCE · SOUTH AFRICA

Consult GALLENKAMP...

Photographs by kind permission of Esso Petroleum Co. Ltd.

For your

LABORATORY REQUIREMENTS

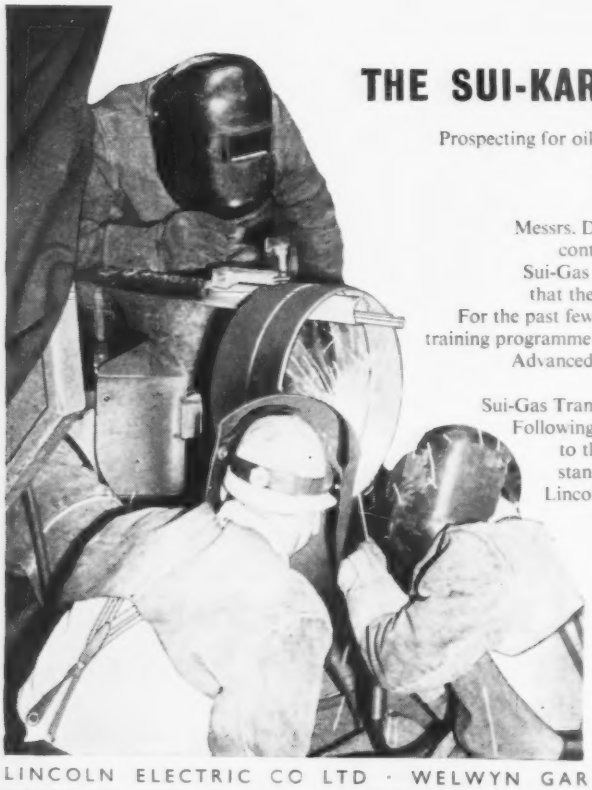
including

PETROLEUM TESTING APPARATUS

to IP and BS Specifications

Catalogue No. 544 sent on request

A. GALLENKAMP & CO., LTD.
17-29 SUN STREET, LONDON, E.C.2



STOVEPIPE WELDING

THE SUI-KARACHI GAS TRANSMISSION LINE

Prospecting for oil 350 miles from Karachi, the Burmah Oil Co. discovered natural gas. A £9-million project will transmit this through 350 miles of 16″ pipe, descending about 750 feet from the Sui range, traversing desert and the irrigated Sukkur plain, then crossing the River Indus.

Messrs. D. & C. and Wm. Press Ltd., one of the Pakistan Construction Group contractors, are working to strict rigid specifications as laid down by the Sui-Gas Transmission Co., a subsidiary of the Burmah Oil Co., who stipulate that the stovepipe (downhand) welding technique must be employed entirely.

For the past few months both companies have given full co-operation in an extensive training programme in this technique and have used the Lincoln welding school facilities. Advanced training in Radiographic examination and interpretation, and in the application of stovepiping has been given to the five Sui-Gas Transmission Co. inspectors who will be in charge of this welded project.

Following this, Messrs. D. & C. and Wm. Press sent all their welding operators to the school for training and testing in this method to API-ASME code standards. Over 60% of these men have achieved Grade A qualifications.

Lincoln SAE 300 Diesel Welders, with Lincoln Fleetweld 5 and Shield-Arc 85 Electrodes, are being used exclusively on this 350-mile gas line.

LINCOLN

World's largest manufacturers of arc-welding equipment and electrodes

LINCOLN ELECTRIC CO LTD · WELWYN GARDEN CITY · HERTS · WELWYN GARDEN 920

SM80

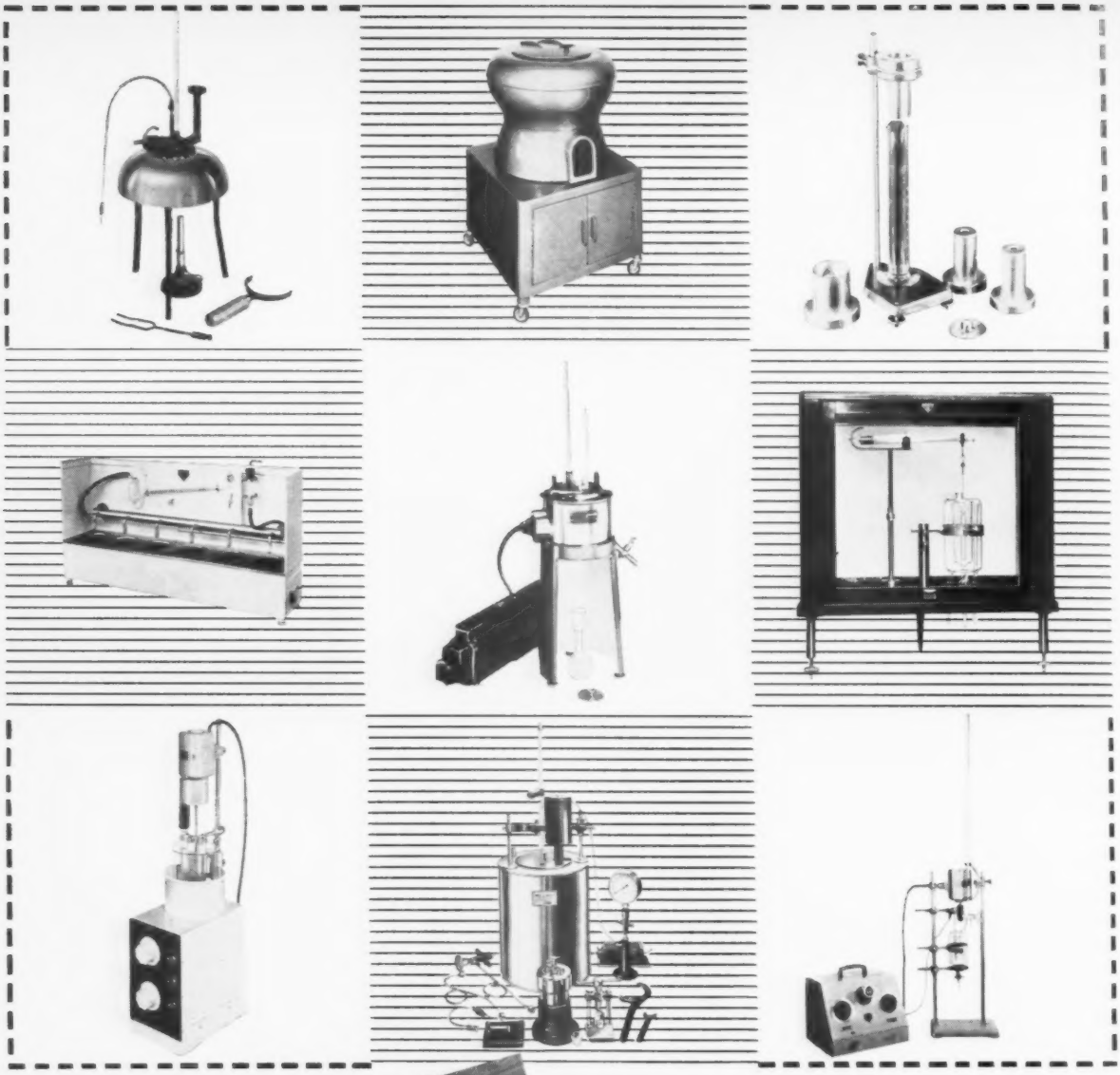
South from Sui

Down to Karachi run the sinews of progress. 350 miles of pipeline link the natural gas resources at Sui with the productive capacity of Southern Pakistan. Industrialisation, the key to progress, needs power; and the power from Sui will be piped direct to Karachi. The new pipeline running south from the Sui range is being constructed by D. & C. and William Press, in association with the Morrison-Knudsen Corporation. D. & C. and William Press Ltd. are associated with constructional projects for the petroleum and allied industries in many parts of the world.

civil, mechanical and chemical contracting engineers at home and abroad

Head Office: 27 Ashley Place, London, S.W.1.
Tel: VICtoria 9751 (6 lines) *'Grams:* Demcopress, London.

D & C
AND WM.
PRESS
LTD.



B T L

INSTRUMENTS, APPARATUS
EQUIPMENT AND
LABORATORY FURNISHINGS

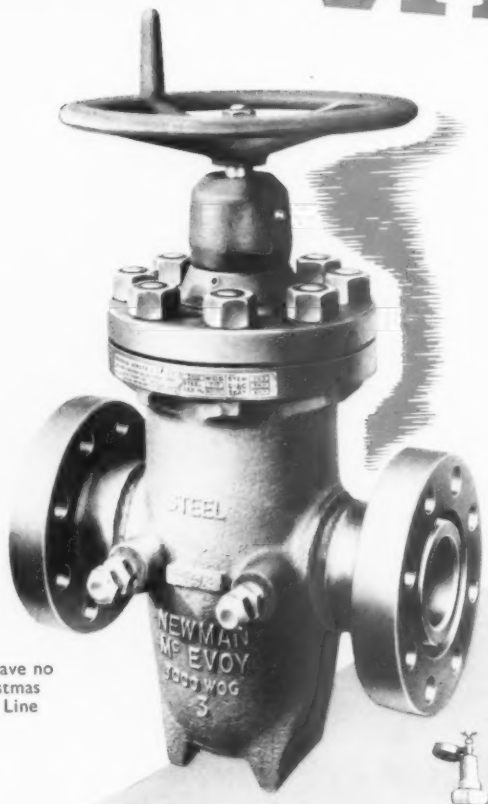
BAIRD & TATLOCK (LONDON) LTD.

SCIENTIFIC INSTRUMENT MAKERS

FRESHWATER ROAD · CHADWELL HEATH · ESSEX

B.I.I.E. Exhibition. See the latest Exhibits on our Stand No. 10, Block F

NEWMAN-McEVOY VALVES



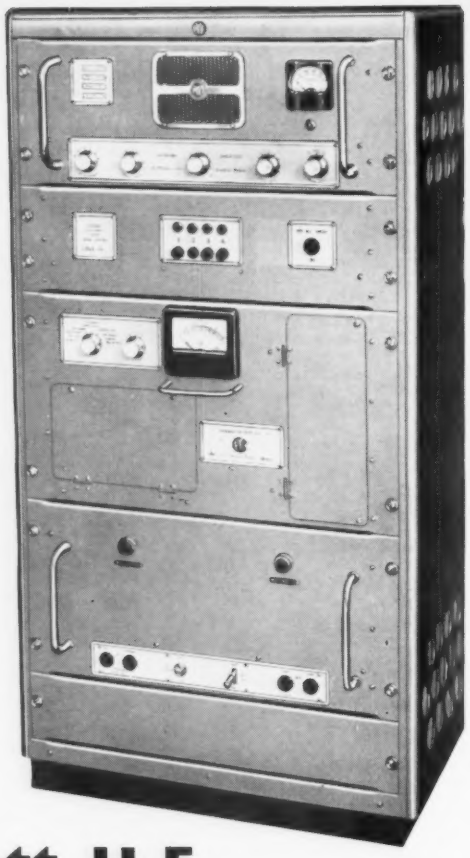
These Valves have no equal for Christmas Tree and Flow Line Service.

AUTOMATIC SELF-SEALING CONDUIT GATE VALVES

Newman-McEvoy Valves are available with Screwed, Socket Weld or Flanged Ends (illustrated). Valves for 1,000 lb., 2,000 lb., 3,000 lb., 5,000 lb., and 10,000 lb. W.O.G. pressures are manufactured in 2", 2½", 3" and 4" sizes. Write for illustrated and descriptive brochure.

N.H. Christmas Tree fitted with Newman-McEvoy Valves, in service at Seria, British Borneo.
Illustration by permission of "SHELL".

Newman, Hender & Co. Ltd. WOODCHESTER STROUD GLOS.



60 Watt H.F.
FIXED STATION

This completely new Pye equipment has been specifically designed for point-to-point communication and will fulfil equally well a ground-to-air role in air traffic control systems.

Push button control brings any one of four preselected channels into immediate operation; this facility is also available when the equipment is installed for remote unattended operation. The 60 watt Fixed Station Transmitter offers R/T, C/W, or M.C.W. operation with 'break-in' facilities on telegraphy.

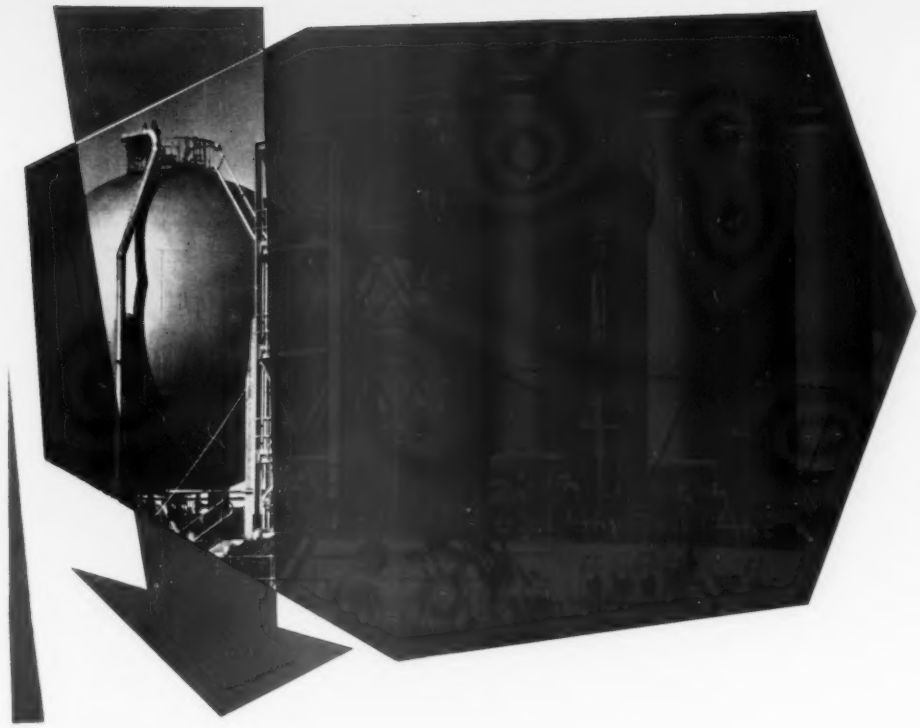
The equipment is suitable for unattended operation in the tropics.

Telecommunications

CAMBRIDGE ENGLAND

Pye (New Zealand) Ltd. Auckland C.I., New Zealand	Pye Canada Ltd. Ajax, Canada	Pye-Electronic Pty., Ltd. Melbourne, Australia	Pye (Ireland) Ltd. Dublin, Eire
Pye Radio & Television (Pty.) Ltd. Johannesburgh South Africa	Pye Limited Mexico City	Pye Limited Tucuman 829 Buenos Aires	Pye Corporation of America 5th Avenue Building 200, 5th Avenue, New York

PYE LIMITED . . CAMBRIDGE . . ENGLAND



HONEYWELL

THE SYMBOL OF RELIABILITY IN THE PROCESS INDUSTRIES

Brown Pneumatic Receiver
Brown Differential Converter
Brown 'ElectroniK' Circular Chart Indicating recording Potentiometer Controller
Brown 'ElectroniK' Strip Chart Potentiometer—Single or Multi-point recorder

BROWN instrumentation is confidently specified wherever reliable supervision of Temperature or Flow is essential.

BROWN ElectroniK Indicators, Recorders, and Controllers for Temperature : BROWN Differential Converters, Pneumatic Receivers and Controllers for Flow. These instruments can bring you permanent —profitable—operating efficiency.

For descriptive literature or advice on specific applications write to Honeywell-Brown Ltd., 1 Wadsworth Road, Perivale, Greenford, Middlesex.

Sales Offices located in the principal cities of Britain and throughout Europe.

Honeywell

BROWN INSTRUMENTS

First in Controls

CORROSION PROBLEMS IN REFINERIES

CAN BE MET BY FITTING

"CAUSEWAY"

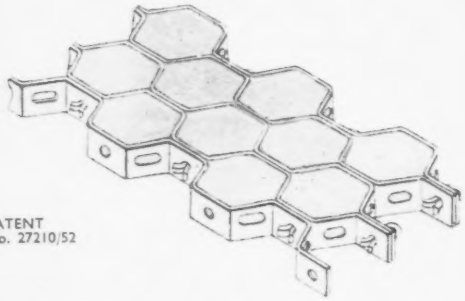
"HEXAGON STEEL"

CELLULAR REINFORCEMENT LININGS

WITH CELL LOADINGS OF REFRACTORIES OR CEMENTS

Causeway Linings may be supplied in Carbon Steel, Stainless, or Monel Metal

A LIGHT-WEIGHT LOADED MONEL METAL MESH CAN BE LESS COSTLY THAN A SOLID MONEL METAL LINER IN CERTAIN APPLICATIONS

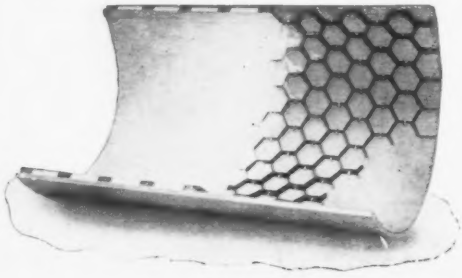


PATENT
No. 27210/52

Note the Slotted Side Walls and Keying Devices which ensure complete immunity against dislodgement of the cement even under the most severe conditions. Several patented variations of the Keying methods are available to suit varying conditions.

Mats are made up in a Wide Range of Sizes, Hex Pitch or Depth, either rivetted as rigid members or having a flexibility to suit any radius from eight inches upwards.

A special Two Way Flexible construction is available for Domed Roofs and Flumed Channels.



Causeway Reinforcement Ltd.

66 VICTORIA STREET, LONDON S.W.1

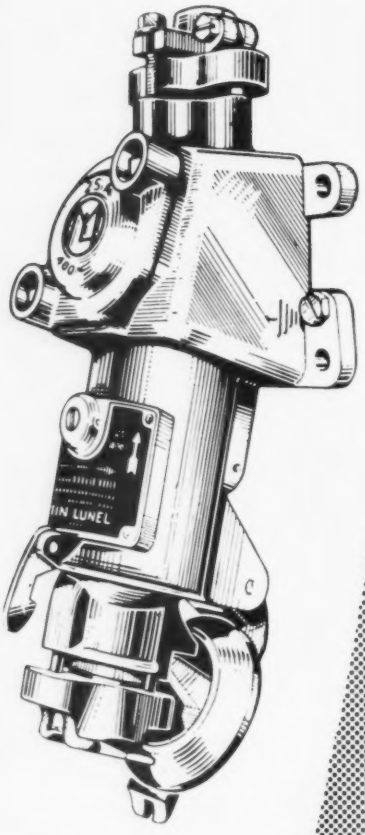
TELEPHONE VICTORIA 8648 and 1873

ALL MATERIAL AND ACCESSORIES FOR JOINTING AND CONNECTORS

FROM 10 TO 250 AMPERES

metalclad · weatherproof · flameproof

Our safety switch socket and plug flameproof connector
10 - 16 - 32 - 63 A. 24 and 400 V



Send for catalogue n° 228

MARTIN & LUNEL

Société anonyme au capital de 30.220.000 Frs

29, Avenue de Bobigny

NOISY-LE-SEC (Seine) FRANCE

Tél. : VILLETTE 16-52 et la suite

ALL EXCEPT THE HELICOPTER

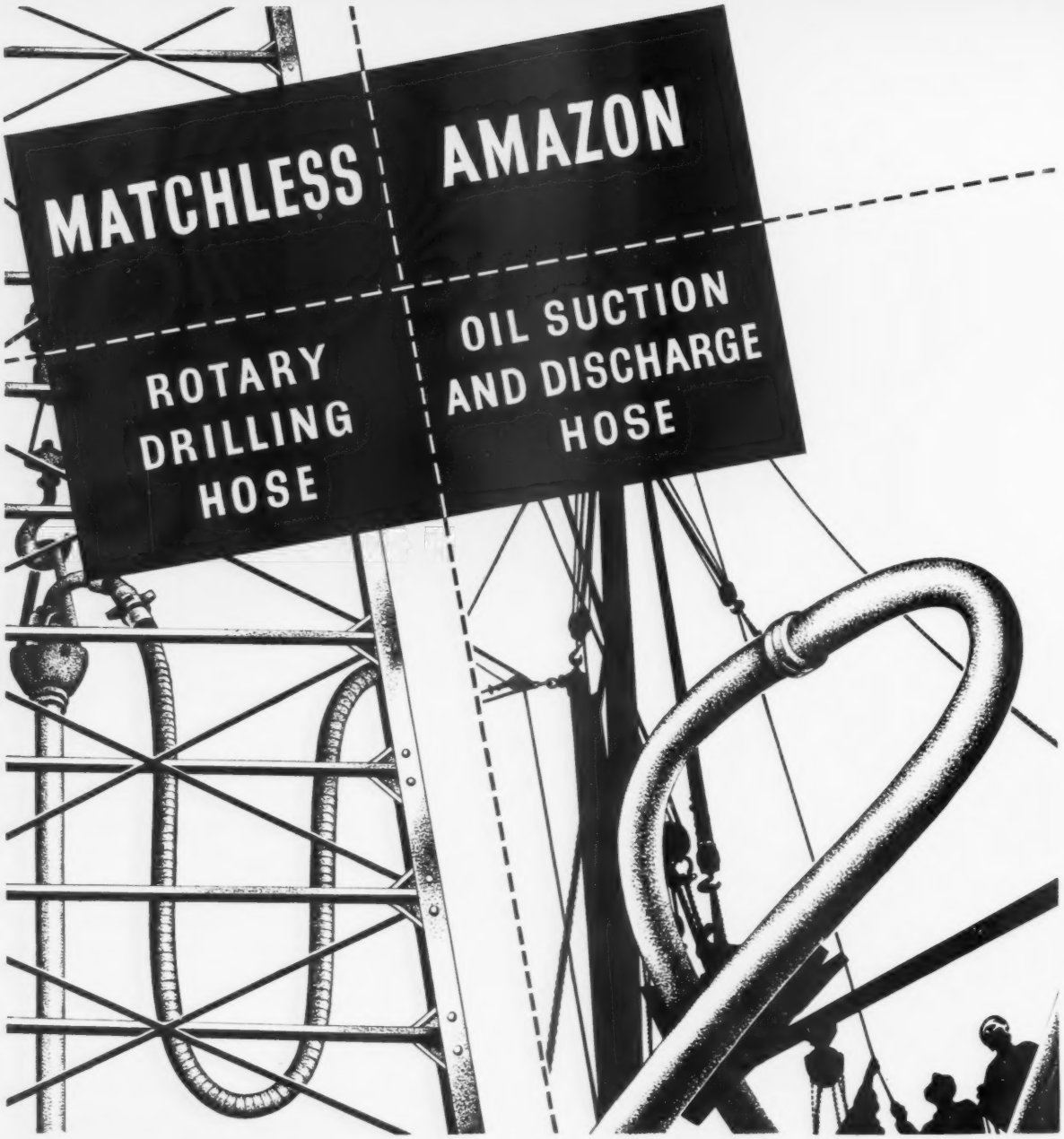
By river, by road, by the iron thread of the nation's railways; by every form of transportation save, as yet, the helicopter—our customers distribute oil from the Thames Haven Installation. And this flow of traffic grows daily.

For here, on the Thames, are a million tons of storage—petroleum products from all over the world—forming the great reservoir which supplies the ever-increasing needs of Greater London and the adjacent areas.

LONDON AND THAMES HAVEN OIL WHARVES LIMITED

3 St. HELENS PLACE LONDON E.C.3 *Tel: AVEnue 6444* THAMES HAVEN INSTALLATION *Tel: Stanford-Le-Hope 2232*

L.3



DOMINION

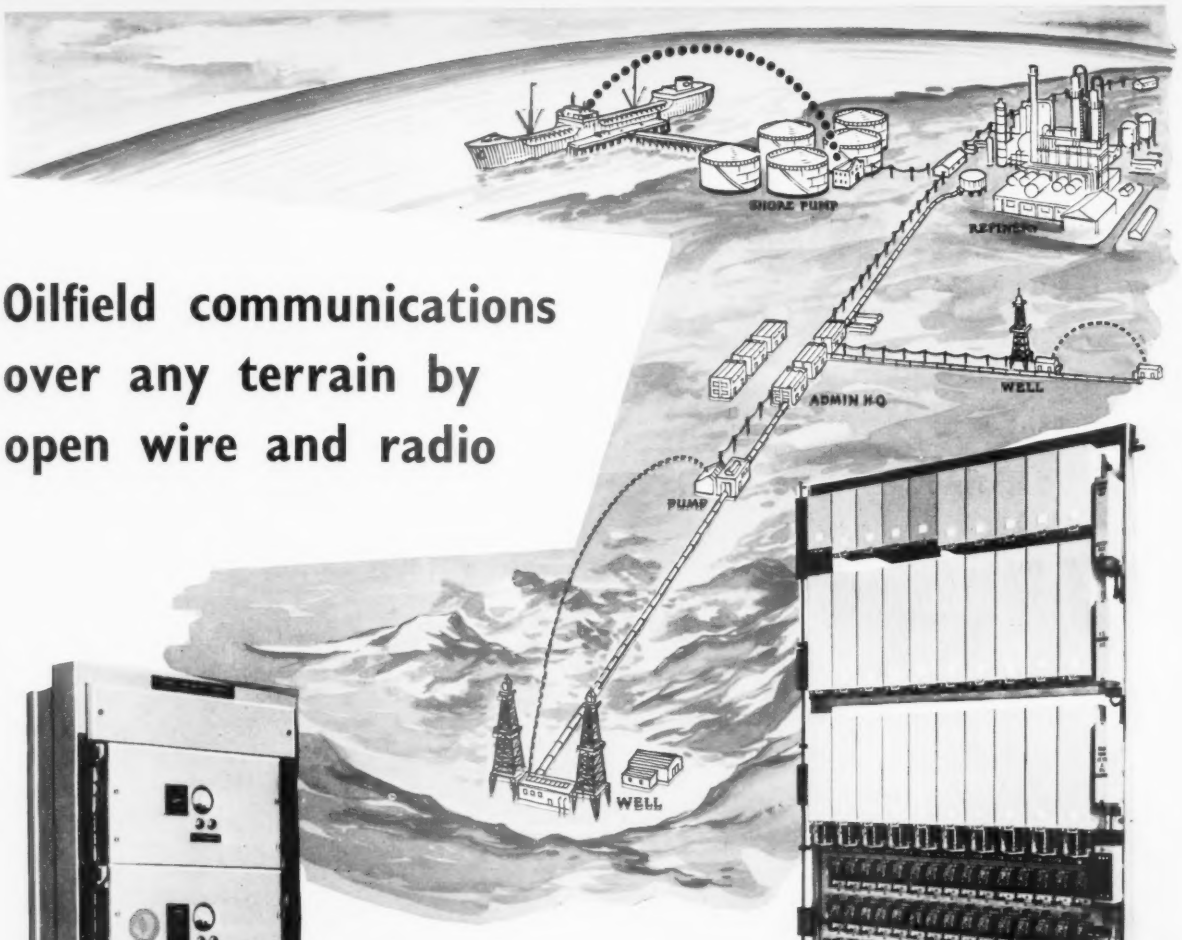
'MATCHLESS' ROTARY DRILLING HOSE AND 'AMAZON' OIL SUCTION AND DISCHARGE HOSE ARE NOW MADE IN GREAT BRITAIN

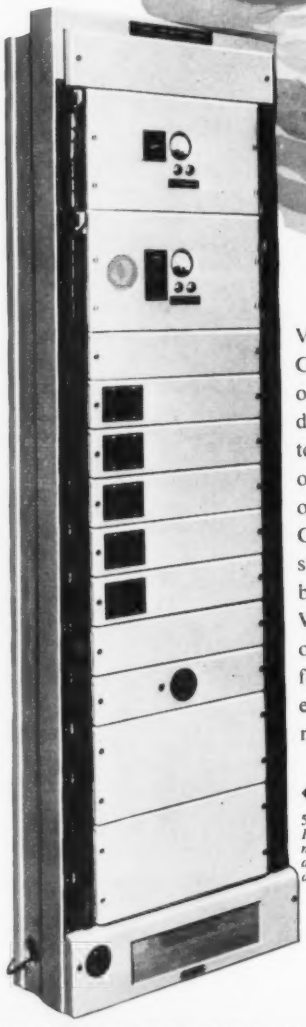
The world's leading hoses for the Oil Industry

DOMINION RUBBER COMPANY, LTD., 62-64 HORSEFERRY ROAD, LONDON, S.W.1

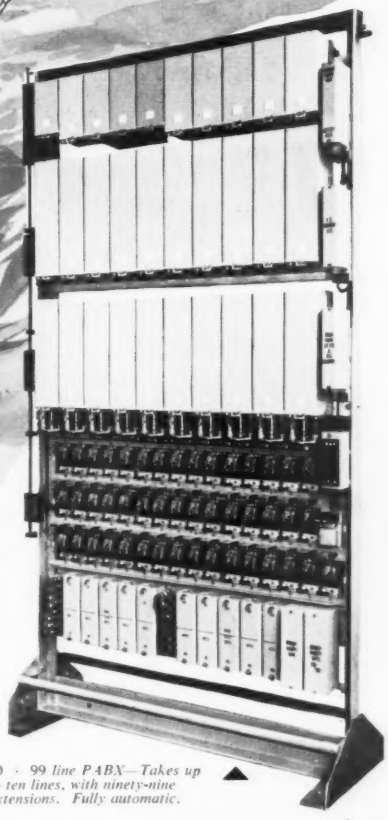
TELEPHONE: ABBEY 2053 · CABLES: KHARTOUM, LONDON

Oilfield communications over any terrain by open wire and radio





5 *Speech Circuit Junction Radio—for use when terrain makes line construction and maintenance difficult. Range approx. 50 miles.*



10 · 99 *line PABX—Takes up to ten lines, with ninety-nine extensions. Fully automatic.*

Vital on-the-spot experience has given G.E.C. a thorough knowledge of the problems of oilfield telecommunications. Mountains, deserts, rivers, swamps, extremes of temperature—all these difficulties can be overcome by a correct combination of open wire and radio linkage.

G.E.C. can often reduce capital costs by the skilful adaptation of existing facilities—buildings, culverts, supports, etc.

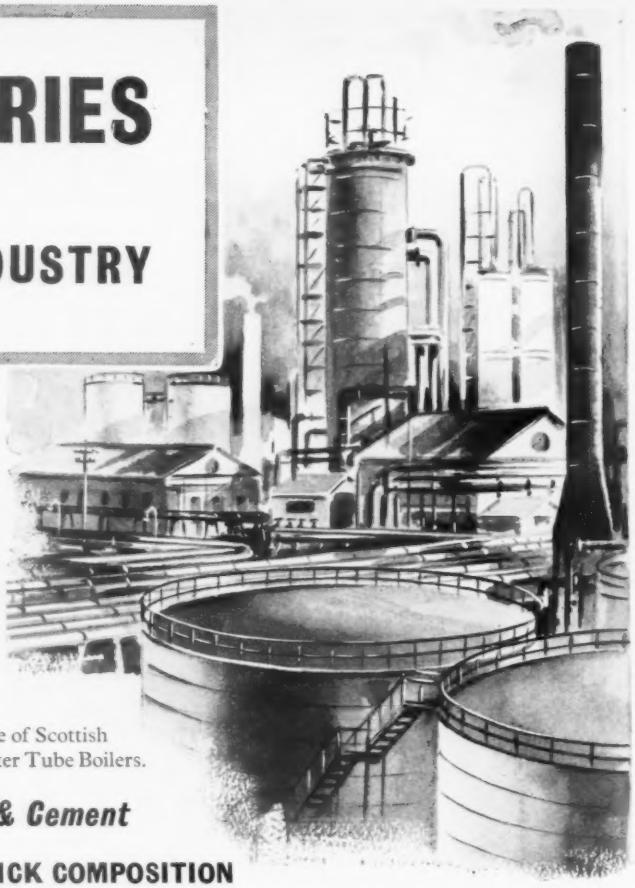
When laying down or expanding oilfields, consult G.E.C. for the most economical, efficient telephone and radio services.

G.E.C.

TELECOMMUNICATIONS

THE GENERAL ELECTRIC COMPANY, LTD., OF ENGLAND. *Telephone, Radio & Television Works:* **COVENTRY, ENGLAND**

'GR' REFRACTORIES
for the
OIL PROCESSING INDUSTRY



Refractory Bricks

SILLMAX RANGE

The G.R. Sillmax range of bricks meets the need for a higher grade brick of the aluminous type. In stills where the conditions are extremely severe, burner rings in G.R. Sillmax materials give superior service. Special cements are available for these bricks.

GLENBOIG RANGE A complete range of Scottish Firebricks for the lining of Oil Tube Stills and Water Tube Boilers.

Compositions, Concrete & Cement

DURAX No.1 PLASTIC FIREBRICK COMPOSITION

Mixed for immediate use. Suitable for rammed linings and patching. Service temperature range 1300/1650°C.

DURAX No.2 REFRACTORY CONCRETE

For casting in situ and making special shapes. Supplied dry. Rapid setting as hard as firebrick: pours into position: no permanent volume change: little tendency to spall. Maximum service temperature 1300°C.

DURAX No.3 REFRACTORY CEMENT

A finely ground air setting cement for jointing all types of firebricks. Supplied dry. Produces thin and strong joints: negligible shrinkage: highly refractory: economical. Maximum service temperature 1650°C.

DURAX No.5 GUNNING OR PLASTERING CEMENT

For application with a pneumatic gun or may be plastered into position. Little rebound loss when applied by gun to Catalytic Regenerators and forms a dense tough lining. Maximum service temperature of 1300°C.

DURAX No.7 REFRACTORY CONCRETE

Super duty refractory concrete with a high alumina base. Applied Similarly to Durax No. 2. Has a hydraulic set, negligible shrinkage on drying. Maximum service temperature of the order of 1550°C.

Insulation

AMBERLITE

INSULATING MATERIAL

A full range of "Hot Face" brick insulation, 'Back-up' Brick and Block Insulation and Cements, Concretes and loose fill are available to meet the requirements of every installation.

GR

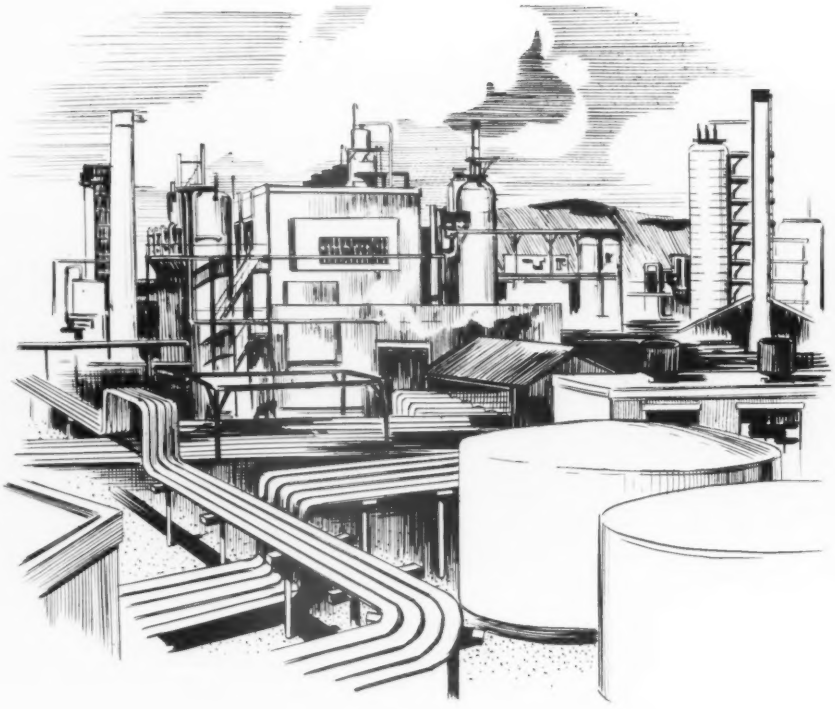
Full particulars, technical data and recommendation for the use of these and other refractories in the G.R. range are available on request.

GENERAL REFRACTORIES LTD

GENEFAX HOUSE · SHEFFIELD 10 · Telephone SHEFFIELD 31113

314

PRESS.....



for Petroleum Pipework

WILLIAM PRESS & SON LTD. INDUSTRIAL PIPEWORK

The design, fabrication and installation of oil refinery Pipework demand a specialised technique and knowledge based on long experience. For over 40 years William Press & Son have undertaken complete industrial Pipework installations, both for the major Oil companies and for many other leading organisations in the country.

Enquiries are invited and are assured of expert attention.

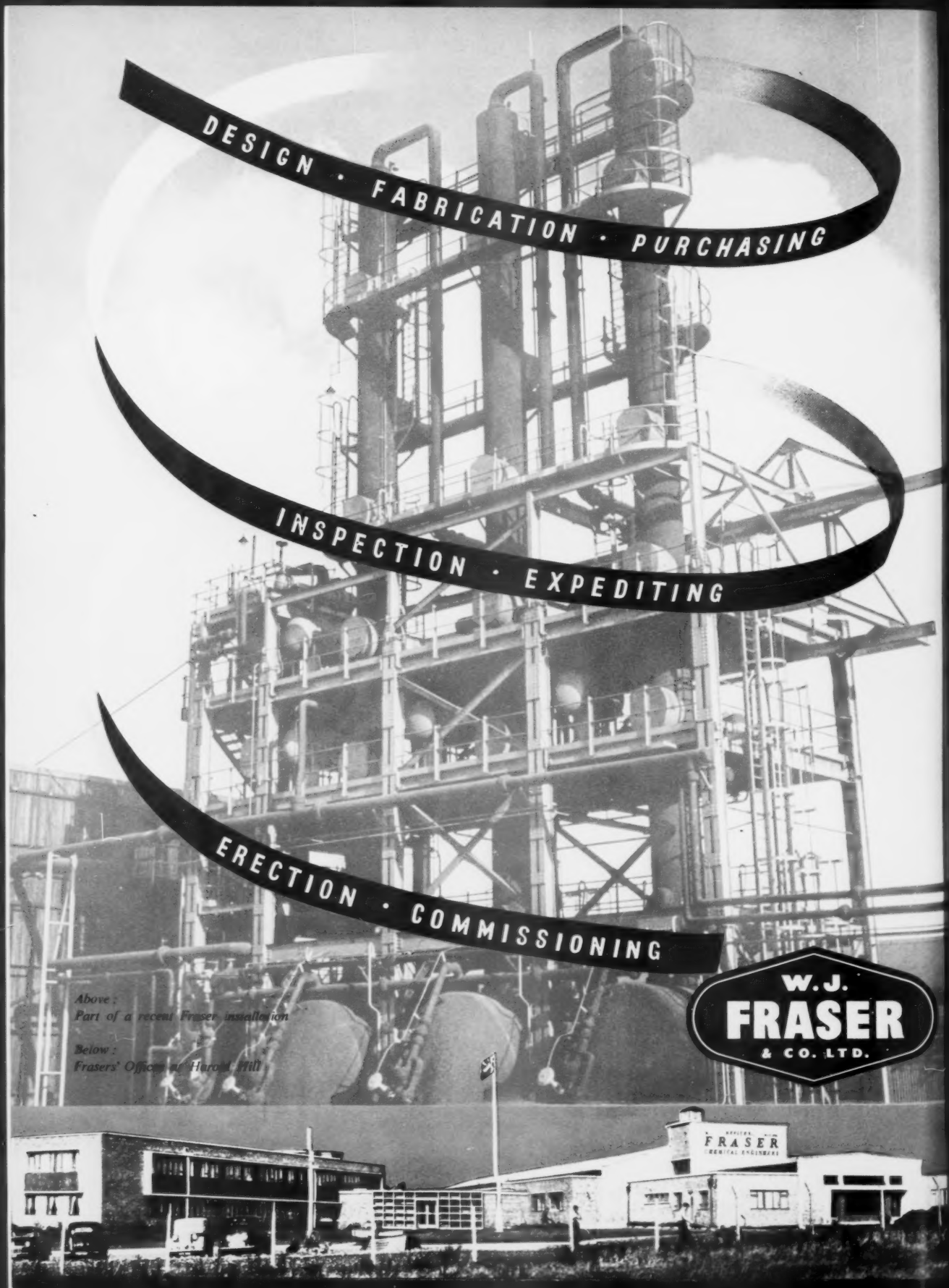
WILLIAM PRESS & SON LTD.

22, QUEEN ANNE'S GATE, WESTMINSTER, S.W.1

Telephone: WHItehall 1752-3 & 2961 — *Telegrams: Unwater, Parl, London*

WILLOUGHBY LANE, TOTTENHAM, N.17

Telephone: TOTtenham 3050 (12 lines) — *Telegrams: Unwater, Southtot, London*



W. J. FRASER & CO. LTD., HAROLD HILL, ROMFORD, ESSEX, SPECIALISTS IN THE ENGINEERING OF PETROLEUM & PETROLEUM CHEMICAL INSTALLATI

A Message

From the President

of the Institute of Petroleum

Modern industry is largely based on scientific discovery and grows and prospers by the application of science and technology both to short- and long-term problems. This is particularly true of our own petroleum industry, the phenomenal growth of which has led to such a transformation in the world's mode and standard of living during the last half-century. Not only have we utilized the results of pure science and engineering but the industry itself has been responsible for many great advances in geology and geophysics, chemistry and chemical engineering, and many other branches of knowledge. It has fostered the development and application of instruments and machines and pioneered many of the modern ideas of business administration and international economic co-operation. The petroleum technologist and the petroleum administrator have indeed played an important part in the creation of higher standards of living and in world development.

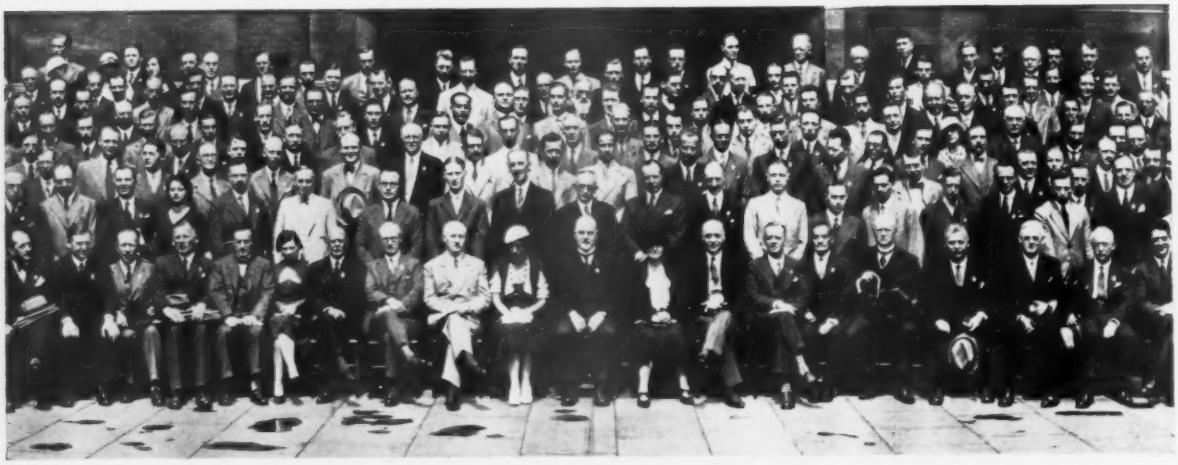
The co-operative spirit of the petroleum industry has long been evident. Knowledge gained has been freely disseminated and we are proud to think that the Institute of Petroleum by meetings, discussions, and publications, has done much to further this process.

Work of this nature by professional societies and publishing bodies throughout the world has been supplemented by international discussions and the World Petroleum Congress has assumed great importance in this respect. Founded by men of goodwill and vision, the first of these Congresses was held in London in 1933. *Its undoubted success led to equally successful events in Paris in* 1937 *and in The Hague in* 1951. *The Fourth World Petroleum Congress is about to commence in the great and historic city of Rome. All who have been privileged to participate in its preparation most confidently anticipate a meeting as fruitful and outstanding in every respect as have been its predecessors. Not only are many important scientific and technical papers to be presented, but the meetings and discussions between old and new friends of many different nationalities are of at least equal importance.*

The Italian Organizing Committee have put in many months of hard work to make the Congress run smoothly and successfully—the arrangements for accommodating several thousand delegates, the organization of the technical sessions and publications and the social events entail an enormous amount of work and we are all greatly indebted to our Italian friends and hosts for all they have done and continue to do.

This issue of the Institute of Petroleum Review *is a Congress Number. It is a normal issue, with many of the usual features, but enlarged to include special articles which we hope will be both interesting and informative to our fellow delegates. We ask them to accept this issue with our best wishes for an enjoyable and successful Fourth World Petroleum Congress.*

DELEGATES AT



THE FIRST WORLD PETROLEUM CONGRESS

LONDON 1933

The World Petroleum Congress

By T. DEWHURST

PAST-PRESIDENT INSTITUTE OF PETROLEUM

PRESIDENT FIRST WORLD PETROLEUM CONGRESS

The First International Petroleum Congress was held in Paris in 1900, and a committee was appointed to arrange future congresses. The second congress was held in Liége in 1905, and the third in Bucharest in 1907. The task of organizing a further congress became increasingly difficult and the committee gradually expired.

Those early years marked the waning of the kerosine age and the dawn of the demand for the modern products of crude petroleum. Oil in commercial quantities had not been discovered in the Middle East, nor in Western Canada, Venezuela, Colombia, Sarawak, etc., while countries such as Trinidad and the Argentine produced insignificant amounts. The first world war demonstrated the importance of petroleum, and was followed by rapid and revolutionary developments in the whole range of petroleum technology. Although there was no attempt to organize a general congress, two International Drilling Congresses were held and were successful in presenting excellent summaries of progress in drilling.

The First World Petroleum Congress

In 1932, several Members of Council of the Institution of Petroleum Technologists proposed that the Institution should provide a forum for the discussion of petroleum problems, notably standardization, and that leading petroleum technologists from other countries should be invited to attend a conference in London in the summer of 1933. At that time the Institution had members in more than fifty countries, and its Journal circulated in about sixty countries. Although the announcement of the conference coincided with the nadir of a severe economic depression, it received a welcome so enthusiastic and general as to indicate that the Institution should arrange a meeting of petroleum technologists from all over the world. The proposed conference therefore evolved naturally into the First World Petroleum Congress.

The Congress had the support of the Government, and several Cabinet Ministers accepted nomination as Honorary Presidents. The guests of honour included ambassadors, high commissioners, and other high officials, and help was rendered by their respective embassies and legations. Five important international bodies associated themselves with the Congress, some twenty-eight countries sent official delegations, and scientific societies and official surveys of many countries were represented.

The Organizing Committee of the Congress had no previous experience of organizing a project of this magnitude and importance, yet within a few months everything was ready and it was possible to present 244 important papers by well-known authorities. The range and quality of the papers and discussions testified to the great advances that had been made in all branches of petroleum technology since the first world war, and confirmed the need for a World Congress to present and record an up-to-date and instantaneous view of the state of petroleum technology.

Visits were paid to works and laboratories, and there was a full programme of excursions and social activities. The many prominent members of the Congress included Dr R. P. Anderson, Dr F. Bergius, Sir John Cadman, Dr A. E. Dunstan, Dr G. Egloff, Dr R. P. Erb, Sir Thomas Holland, J. B. Aug Kessler, Professor L. Ubbelohde, and Professor H. Weiss.

The Second World Petroleum Congress

The Second World Petroleum Congress was held in Paris during the Exposition Internationale of 1937, and was under the high patronage of the President of the French Republic, supported by leading members of the Government. Colonel Louis Pineau was President of Honour, the President being M. Charles Bihoreau. The inaugural meeting was held on 14 June, and was followed by a Séance Solonnelle in the presence of the President of the Republic.

The writer was involved in Congress problems from 1932 until 1937, and therefore in his opening address at the inaugural meeting of the Second Congress he stressed the need for a Permanent Council, and also for the establishment of a Congress Secretariat in London, and these proposals were passed as resolutions at the plenary session of the Congress.

The 1630 members of the Congress included official delegates from twenty-six countries, and the meetings were held in the spacious halls and rooms of the magnificent Maison de Chimie. Some 392 papers of high quality were presented and discussed, and the results were summarized at the final meeting by the chairmen of the technical sections. Ipatieff, Egloff, Ubbelohde, and Huber Ruf were among those who made noteworthy contributions to discussions on their special subjects. Other outstanding and active personalities included Lord Cadman, Professor Mrazec, Colonel E. O. Thompson, and the redoubtable A. Guiselin.

Visits to laboratories and works, and excursions of general interest, were well attended, while the social arrangements, which included a magnificent banquet, a dinner in the Orangery, the illuminations at Versailles, the flood-lit Louvre, and other varied attractions, provided unforgettable memories of characteristic French hospitality and artistry.

At the first meeting of the Permanent Council, Professor Ubbelohde urged that the Third Petroleum Congress should be held in Germany. Alternative proposals were discussed, but were abandoned owing to technical difficulties, and it was decided to accept the German invitation. In 1939, the Organizing Committee submitted to the Permanent Council an excellent preliminary programme, but the international situation deteriorated and the project was dropped.

Third World Petroleum Congress

The war and its sequelae greatly delayed any decision as to the time and venue of the Third Congress, but in due

course the Council welcomed and accepted the offer of the Dutch Royal Institute of Engineers to organize the Congress in Holland. The Congress was therefore held at the Hague in 1951, under the patronage of His Royal Highness The Prince of the Netherlands; a number of prominent members of the Congress had the honour of being received by Her Majesty The Queen of the Netherlands at the royal palace at Soestdijk.

The President of the Congress was Jonkheer van Lidth de Jeude, a remarkably successful civil engineer, who was also a politician, having held office twice as Minister for War. Although in poor health, he impressed everyone by his character and ability.

A highly efficient Organizing Committee, aided by a large secretarial staff, carried out a magnificent feat of organization which evoked general admiration and gratitude. Scheveningen, the attractive seaside resort of the Hague, provided an ideal setting for the Congress.

The solemn opening ceremony in the lovely and historic Ridderzaal was moving and impressive and gave a touch of ancient pageantry to the inauguration of a Congress dealing with the latest technical developments of a modern industry.

The membership totalled 2753, and thirty-four countries were represented by national committees and delegates. It was satisfactory that leading petroleum institutions and oil companies in the United States were represented, and that the Committee of Honour included Lieutenant-General E. O. Thompson and Dr W. E. Wrather, representing the United States Government, and also Frank Porter, the genial and able President of the American Petroleum Institute.

Some 280 selected papers were presented and keenly discussed, as shown by the many sectional resolutions submitted at the final session. In addition, four important lectures on general topics were given by well-known authorities. There was also a large programme of industrial and general excursions, and the attractive social functions included the official banquet, the reception by the Netherlands Government in the Kasteel Oud Wassenaar, and the farewell evening given by The Royal Dutch Shell Group at "Avifauna", Alpen-on-Rhine. It was not surprising that, at the plenary session, representatives of the principal countries expressed thanks for the generous hospitality they had received, and stressed their admiration for the magnificent organization of the Congress.

In January 1952, the Permanent Council welcomed and accepted unanimously an invitation to hold the Fourth Congress in Italy in 1955. A strong Organizing Committee and numerous national committees were set up and quickly settled down to work. It was wisely decided to limit the number of papers so as to concentrate on quality and to allow adequate time for discussion. The Eternal City should provide an impressive setting for the Congress, while Italy is unique for excursions to places of interest and beauty.

Research and Fellowship

Time does not permit adequate discussion of sectional resolutions at the plenary sessions and sometimes not even at sectional meetings. Congress has neither the funds nor the facilities to undertake directly the researches proposed by the resolutions, but the Permanent Council can and does act as a catalyst in promoting and co-ordinating proposed items of research. Sectional resolutions should therefore be submitted as recommendations to the Permanent Council, and resolutions moved at plenary sessions limited to those which affect Congress as a whole.

The Congress has been fortunate in the constitution and personnel of the Permanent Council, and notably in its chairmen. It is broadly based, the western hemisphere being represented by Canada, Mexico, Venezuela, and the United States. It is to be hoped that it will be possible to hold the Congress in the United States in 1959, the centenary of the Drake well and of the petroleum industry.

The Congress is invaluable in arranging periodic reunions of the petroleum technologists of the world, and in providing a forum for discussions which act as stimuli to further research. Moreover, the meeting of experts from many lands, with a common interest and in the harmonious setting of a Congress, must foster international goodwill and understanding.

The Congress was initiated during the most severe economic blizzard on record, and has survived the second world war and the preceding and subsequent periods of strained and unsettled international relations. Having weathered these storms, its future success would seem to be assured.

In conclusion, the writer may perhaps be permitted to quote from his opening address at the inaugural meeting of the Congress in Paris:—

> "In its final analysis, therefore, the Congress was founded on research and fellowship and its success has been due to the purity and strength of these underlying motives. It has been said that the spirit liveth but the letter killeth and whether or not the words research and fellowship ever become enshrined in our written constitution, they must nevertheless remain forever the watchwords and the living spirit of the Congress so that all ulterior objectives may thereby be excluded and that everything said and done in connexion with the Congress might, if necessary, be written in letters of gold across the sky."

★ ★ ★

OIL EXPLORATION IN CANADA

Survey work is being carried out in Canada by geologists of the D'Arcy Exploration Company, The British Petroleum Company's prospecting subsidiary, in conjunction with Canadian geologists. The D'Arcy Exploration Company purchased in 1953 a substantial interest in the Triad Oil Company of Calgary, Alberta, which has interests in oil properties in Alberta, Saskatchewan, Manitoba, and the Williston Basin.

A survey party in camp during work in the Rocky Mountains
A BP photo

The Italian Petroleum Industry

Aspects and Problems

By GOFFREDO COZZI

Ever since its inception, the Italian petroleum refining industry has been faced with an almost complete lack of domestic crude oil resources, and hence with the need for importing crude oil. In 1953, the Italian crude oil production totalled only 80,000 tons, as compared with 6,800,000 tons needed for refining into the products required by the domestic market. Efforts were made to obtain from the imported crude oil the range of products which appeared necessary to meet market requirements, which—at least till 1950—far exceeded the aggregate throughput of Italian refineries.

Table I presents a detailed picture of the size and trends of the Italian petroleum market from 1926 to 1938.

TABLE I

ITALIAN IMPORTS OF CRUDE OIL AND OIL PRODUCTS

Year	*Crude oil*	*Gasoline*	*Kerosine*	*Residual fuel oils*	*Lubricants*	*Total*
1926	31	217	135	374	77	834
1927	47	256	147	414	81	945
1928	50	322	144	421	82	1,019
1929	60	387	162	590	83	1,279
1930	96	390	156	772	85	1,499
1931	101	367	148	804	73	1,493
1932	127	325	146	835	66	1,499
1933	135	291	137	1,081	57	1,711
1934	143	348	150	1,122	66	1,829
1935	219	369	149	1,240	70	2,049
1936	300	208	111	1,136	55	1,812
1937	881	254	92	1,193	76	2,497
1938	1,474	99	52	955	44	2,624

The following facts are evident from the Table: (*a*) total imports increased more than three-fold in the 12 years considered; (*b*) the percentage of crude oil imported showed a steady rise, reaching by 1938 over 50 per cent of the total quantity imported; (*c*) the imports of high-grade petroleum products showed a decline, first slow and then much faster, except for fuel oil.

The developments which took place after 1938 confirmed these trends, and since 1950 Italy has become an exporter of finished petroleum products.

In the many years which preceded these developments, the Italian refining industry was very modest, first refining the small quantities of domestically-produced crude oil in a non-competitive regime, and then surviving as a result of customs protection. Hence the continued existence of old plants which survived through a number of adaptations and now operate alongside a powerful group of a few modern plants. This industry, which now finds it difficult to cope with present requirements since conditions resulted in the construction of uneconomically-sized plants (as indicated by a study of the average refinery capacity), now presents a highly complex picture, because of the diversity and disproportion now prevailing among the 36 existing refineries, only 12 of which have a capacity in excess of 500,000 tons.

Another troublesome factor is the disproportion between domestic consumption and production capacity.

It is interesting to consider how we arrived at the situation shown in Table II.

Without going too far back, it can be recalled that in 1945, at the end of the war, one refinery only was in operation in Italy—the 250,000-ton Bari refinery. The Leghorn refinery, after the equipment had been removed by the Germans, had suffered almost complete destruction of its buildings, and the other refineries did not operate, either because of the damage suffered or owing to the lack of crude oil.

In 1945, the total Italian refining capacity was down to 650,000 tons, or about 45 per cent of the crude oil refined in 1937.

To meet the most pressing Italian needs, in 1943 and 1944 the Allied Administration made available the following products.

	Tons
Gasoline	164,059
Kerosine	69,640
Diesel oil	166,523
Fuel oil	242,691
Lubricants	44,979
Paraffin	2,732
Bitumen	14,101
	704,725

In 1946, Italian imports were as follows.

	Tons
Gasoline (aviation and auto)	311,130
Kerosine	152,112
Diesel oil	326,178
Fuel oil	1,125,975
Lubricants	51,208
Other products	121,081
	2,087,684

The criteria followed in rebuilding the Italian refining industry showed no departure from those adopted in the past, and there was no immediate understanding of the need for concentration. As compared to the old plants, however, the new refineries constitute noteworthy achievements, to which foreign enterprises have made an extensive contribution. In effect, foreign capital plays a substantial role in the Italian petroleum industry.

In 1952, 34 per cent of the capital invested was owned by British and American companies; 31 per cent was owned by joint Italian-foreign enterprises, and 35 per cent was Italian capital. Translated in terms of production capacity, this means that foreign capital accounted for 5,954,000 tons, joint capital for 6,630,000 tons, and Italian capital for 8,148,000 tons.

TABLE II

ITALIAN INDUSTRIAL FACILITIES FOR CRUDE OIL PROCESSING

(as on 30 November, 1954)

Region and Refinery	*Location*	*Processing capacity as per Govt. permit (tons)*	*Authorized capacity + 30% reserve (tons)*	*Distillation thousands of tons per year*	*Reforming*	*Cracking*	
						thermal	*catalytic*
					(*tons per working day*)		
Piemonte							
R.O.L.	Viguzzolo (Alessandria)	50,000	65,000	70	—	—	—
SARPOM[6]	Trecate (Novara)	1,000,000	1,300,000	900	666	—	—
S.A.R.N.	Novara	70,000	91,000	—	—	—	—
Liguria							
delle Piane[3]	Genova	47,500	61,750	50	—	—	—
Garrone	Genova	300,000	390,000	200	250[a]	—	—
Inpet	La Spezia	1,500,000	1,950,000	1,610	360	—	—
Iplom[3]	Genova	30,000	39,000	40	50[a]	—	—
Purfina (ex Permolio)	Genova	240,000	312,000	310	80[a]	—	340
San Quirico[3]	Genova	60,000	78,000	80	20[b]	—	—
Lombardia							
Bianchi petroli	Cologno Monzese	52,000	67,600	—	—	—	—
Casati	Cervignano d'Adda	—	—	—	—	—	—
Condor	Rho	1,400,000	1,820,000	1,980	—	—	2,000
Icip	Mantova	200,000	260,000	260	500	500	—
Ilsea[1,3]	Valmadrera (Como)	90,000	117,000	120	60[a]	—	—
Italia	Cremona	100,000	130,000	—	—	—	—
Lombarda petroli[4]	Villasanta (Milano)	200,000	260,000	210	66[b]	—	—
Nilo[2]	Milano	45,000	58,500	60	60[a]	—	—
Purfina (ex Permolio)	Milano	220,000	286,000	290	80[a]	—	—
Volpato[3]	Milano	25,000	32,500	30	35[b]	—	—
S.I.R.O.M.	Milano	—	—	70	4[b]	—	—
Veneto e Venezia Giulia							
Aquila[1,6]	Trieste	900,000	1,170,000	900	370	—	—
Cicsa	Porto Nogaro	—	—	—	—	—	—
Esso Standard	Trieste[1]	250,000	325,000	300	150	—	—
I.R.O.M.[7]	Porto Marghera (Venezia)	1,100,000	1,430,000	1,470	900	100	100
Emilia-Romagna							
Agip—Mineraria	Cortemaggiore	100,000	130,000	—	—	—	—
Montecatini	Ferrara	—	—	—	—	—	—
Petroli d'Italia	Fiorenzuola d'Arda	160,000	208,000	210	80	300	—
Sarom[2,8]	Ravenna	540,000	702,000	460	300	—	—
Spi[3]	Fornovo-Taro	30,000	39,000	40	—	—	—
Toscana							
Dica[3]	Avenza (Carrara)	100,000	130,000	140	60[a]	—	—
Galletti[3]	Firenze	140,000	182,000	180	100	—	—
Stanic	Livorno	1,500,000	1,950,000	1,700	450	—	—
Stoi[3]	Firenze	100,000	130,000	130	60	—	—
Lazio							
Purfina (ex Permolio)	Roma	240,000	312,000	310	80[a]	—	340
Marche							
A.P.I.	Falconara	500,000	650,000	650	400	—	—
Campania							
Golfo	Gaeta	—	—	—	—	—	—
Socony Vacuum	Napoli	2,800,000	3,640,000	3,330	850	—	1,800
Puglie							
Stanic[1,5]	Bari	1,400,000	1,820,000	1,770	560	—	—
Sicilia							
Augusta Petrolchimica	Palermo	—	—	—	—	—	—
Islom	Palermo	—	—	—	400	—	—
Ra.Si.O.M.	Augusta	1,700,000	2,210,000	450	312[b]	530	—
Total		17,189,500	22,346,350	18,320	7,303[c]	1,430	4,580

[a] Reforming and de-sulphurizing plants.
[b] Catalytic de-sulphurizing plants.
[c] Of which 523 metric tons is from catalytic desulphurization.
[1] These refineries have applied for permission to increase capacity above the authorized limit.
[2] Planned, now in the design stage.
[3] As indicated by the Italian Government to OEEC in February 1952, the modest capacity of these refineries was not initially included in the country's aggregate capacity. For technical and economic reasons, however, some of these plants had to increase their capacity.
[4] Allowance was made for a 426-ton daily cracking capacity, the product being used for distillation.
[5] Allowance was made for a 1000-ton daily cracking capacity, the product being used for distillation.
[6] These refineries have announced that they plan to build catalytic cracking plants, and will file plans with the Committee.
[7] The Company has cancelled its plans for construction of a catalytic cracking plant.
[8] The Company has announced that it plans to build lubricant plants, and will file plans with the Committee.

TABLE III

PRODUCTION AND AVERAGE YIELD OF ITALIAN REFINERIES

Product	1948		1949		1950		1951		1952		1953	
	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent
Gasoline	418	17·8	708	18·2	984	18·1	1,358	18·1	1,762	17·8	2,191	17·9
Kerosine	192	8·2	229	5·9	299	5·5	469	6·3	614	6·2	806	6·6
Diesel oil	514	21·9	773	19·8	1,040	19·1	1,408	18·8	1,812	18·3	2,395	19·5
Fuel oil	917	39·0	1,704	43·7	2,428	44·5	3,317	44·2	4,603	46·5	5,612	45·8
Others	309	13·1	486	12·4	699	12·8	948	12·6	1,109	11·2	1,246	10·2
Total crude oil processed	2,350	100·0	3,900	100·0	5,450	100·0	7,500	100·0	9,900	100·0	12,250	100·0
Annual percentage increase			+66		+40		+38		+32		+23·7	

*Including losses and refinery consumption.

It should be noted, however, that no Italian capital was invested in bond issues floated by foreign companies.

Table II also shows plants for the processing of by-products, which are not considered in our statistics.

In 1938, Italy possessed the following full-cycle plants: ANIC (now STANIC) at Leghorn and Bari, the capacity being respectively 360,000 and 300,000 tons; Aquila at Trieste, 300,000 tons; IMPET at La Spezia, 300,000 tons; Socony Vacuum at Naples, 220,000 tons; ROMSA at Fiume, 125,000 tons; Esso Standard, Trieste, 90,000 tons; AGIP (now IROM) at Marghera, 375,000 tons.

Atmospheric-distillation and refining plants were: PERMOLIO'S (now PURFINA) three plants, with a capacity of 40,000, 40,000, and 60,000 tons; the Petroli d'Italia plant at Fiorenzuola (20,000 tons); the Standard Plant at Fornovo (20,000 tons), and the Lombarda Petroli Plant at Villasanta (10,000 tons).

Adding minor plants, the 1938 total refining capacity equalled 2,260,000 tons.

From 1938 to 1945, the small new plants built accounted for an additional 600,000-ton capacity, and existing plants were enlarged: IMPET, La Spezia, from 300,000 to 1,000,000-ton capacity; Socony Vacuum from 220,000 to 2,000,000 tons; AQUILA from 300,000 to 600,000 tons.

After 1950, new plants were built by SARPOM, Condor, ICIP, SAROM, API, RASIOM, AGIP Mineraria. The Leghorn refinery was rebuilt to 1,500,000-ton capacity, and the larger existing refineries were further enlarged.

The present geographical distribution of production capacity, based on Government permits, is shown below:

Region	Tons
Piemonte	1,120,000
Liguria	2,177,500
Lombardia	2,232,000
Veneto and Venezia Giulia	2,255,000
Emilia and Romagna	730,000
Tuscany	1,840,000
Lazio	240,000
Marche	500,000
Campania	2,800,000
Puglie	1,300,000
Sicily	1,000,000

In 1953, the Italian refining industry processed about 13,000,000 tons of crude oil, as compared with 2,120,000 in 1947 and 1,900,000 in 1938.

These three years were taken as a point of reference in order to trace a picture of the per cent variations in sources of crude oil supply, as shown here:

Year	Europe	Middle East	U.S. Gulf	Venezuela	Others	Total
1938	20·20	14·40	36·93	0·91	27·56	100
1947	0·42	54·96	25·46	16·49	2·67	100
1953	0·20	91·20	0·88	7·72	—	100

Let us now consider Italian consumptions, separately for the pre-war period (1932 to 1938) and the post-war period.

TABLE IV

ITALIAN CONSUMPTION OF PETROLEUM PRODUCTS, 1932-39

(*metric tons*)

Year	Gasoline	Kerosine	Diesel oil	Fuel oil
1932	475,800	181,700	183,500	460,460
1933	458,000	184,000	224,000	614,700
1934	477,000	189,000	268,500	713,000
1935	460,000	198,500	284,000	967,000
1936	300,000	165,000	188,000	910,000
1937	477,000	187,700	220,500	1,006,000
1938	455,000	170,000	261,500	935,500

A comparison between the two tables of production and consumption of petroleum products shows that the need to export has been steadily increasing since 1948, because the annual production increment averaged 40 per cent while total consumption increased in the same years, from 1948 to 1953, by an average of 16 per cent a year.

This is why Italian exports rose from 950,000 tons in 1950 to 1,420,000 tons in 1951, 2,900,000 tons in 1952, and 5,100,000 tons in 1953.

Even with an intensive drive to boost domestic consumption, it is unthinkable that the Italian market will ever be able to absorb all the production surplus.

According to the most reliable estimates available, the breakdown of this surplus is as shown in Table VI.

Since the possibility is being discussed, in accordance with the decisions adopted by OEEC, of stopping the construction of new plants in Italy, serious problems arise in connexion with normalizing the market and obtaining appropriate refinery yields.

The problem is to obtain: (*a*) greater domestic consumption; (*b*) foreign market outlets; (*c*) production quantities appropriate to the requirements of foreign and domestic markets; and (*d*) production qualities appropriate to the requirements of foreign and domestic markets.

TABLE V

ITALIAN CONSUMPTION OF PETROLEUM PRODUCTS, 1948-53

Product	1948		1949		1950		1951		1952		1953	
	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent	1,000 ton	Per cent
Gasoline	450	15·0	560	15·7	670	14·5	780	14·9	905	15·7	1,035	16·1
Kerosine*	140	4·6	155	4·4	190	4·1	195	3·6	214	3·6	215	3·3
Diesel oil	470	15·7	600	16·9	760	16·4	890	16·9	1,053	18·2	1,230	19·1
Fuel oil	1,700	56·7	1,950	54·8	2,600	56·3	2,940	55·9	3,050	52·8	3,400	52·8
Others	240	8·0	294	8·2	403	8·7	451	8·7	552	9·7	560	8·7
Total	3,000	100·0	3,559	100·0	4,623	100·0	5,256	100·0	5,774	100·0	6,440	100·0
Annual percentage increase			+18·6		+30		+13·7		+9·9		+11·5	

*Including jet fuel.

It should be noted that Italy has a low consumption of gasoline and a large consumption of fuel oil, accounting respectively for 17 per cent and 53 per cent of the total petroleum consumption. In the United States the opposite situation prevails, with gasoline accounting for 43 per cent and fuel oil for 21 per cent of total consumption.

Table II also shows clearly that, in terms of processing capacity (throughput), the ratios between the various types of plants are the following:

Distillation	100
Reforming	14
Thermal cracking	0·305
Catalytic cracking	8·4

This breakdown provides the clearest picture of the present technical structure of the Italian oil industry and suggests these thoughts: considering the domestic total, a very large primary distillation capacity is accompanied by an insufficient cracking capacity, while the distillation—reforming ratio indicates a trend towards production of high-octane gasoline.

In effect, the smaller refineries also struggle for a share of the gasoline market, from which higher-grade products tend to squeeze them out.

This is the most salient aspect of the refining industry in Italy, which is connected with the technical improvement of plants.

A concentration of smaller enterprises is not impossible, but for the time being is opposed by a certain individualism which has always been a typical Italian characteristic.

On the other hand, we do not see how the smaller refineries can convert their plants to obtain higher efficiency. A past trend towards the production of modern petrochemicals has not produced any concrete result.

Lastly, the exporters are worried about the reappearance on the Middle East market of the Abadan production. Fortunately, the major exporters operate within the framework of large-scale international barter deals.

TABLE VI

ESTIMATED ITALIAN SURPLUSES OF THE FOUR MAJOR PETROLEUM PRODUCTS, 1954-57

(*thousand tons*)

Year	Gasoline*	Kerosine†	Gas oil	Fuel oil	Total
1954					
Production	2,920	700	2,580	6,300	12,500
Domestic consumption	1,150	250	1,350	3,500	6,250
Surplus	1,806	450	1,230	2,800	6,286
1955					
Production	3,170	750	2,780	6,680	13,380
Domestic consumption	1,250	265	1,500	3,600	6,615
Surplus	1,956	485	1,280	3,080	6,801
1956					
Production	3,300	770	2,880	6,830	13,780
Domestic consumption	1,350	270	1,700	3,700	7,020
Surplus	1,986	500	1,180	3,130	6,796
1957					
Production	3,440	800	3,000	6,960	14,200
Domestic consumption	1,450	275	1,900	3,800	7,425
Surplus	2,026	525	1,100	3,160	6,811

*The gasoline surplus includes 36,000 tons of gasoline obtained from natural gas.

†Including jet fuel.

★ ★ ★

ILO PETROLEUM COMMITTEE

Contract labour problems and human relations in the world's oil industry were among the subjects for discussion at the fifth session of the Petroleum Committee of the International Labour Organization at Caracas, Venezuela, from 25 April to 7 May. Reports were prepared by the International Labour Office on both these subjects and these were discussed by government, worker, and employer delegates from sixteen oil producing and refining countries.

A third report which was also discussed dealt with industrial and economic aspects of petroleum and described recent developments in exploration and development operations, petroleum refining, and the demand and supply of petroleum. An account was given of the employment situation in a number of petroleum producing or refining countries, hours of work were considered, and a survey was made of industrial relations.

The Institute of Petroleum

By **GEORGE SELL** (Fellow), Editor

Founded in 1913 and incorporated in 1914 as the Institution of Petroleum Technologists, The Institute of Petroleum is the only society or institution in the United Kingdom concerned solely with the petroleum and allied industries. The original conception of the Institution as formulated by the founders, Sir Boverton Redwood and Arthur W. Eastlake, was a body to bring together the technical specialists of the

In this room the Council of the Institute holds its monthly meetings, and the room is also used for meetings of the larger committees.

industry, to facilitate the free interchange of technical information about petroleum, and to advance the knowledge of the science of petroleum.

For the first 20 years of its existence the Institution had been concerned mainly with the needs of the technologist—the geologist, the chemist, the engineer, and the chemical engineer. The subsequent expansion of the industry led to the realization that there were many others, besides the technologists, who would benefit by an opportunity of discussing their problems. Accordingly, in 1938, after due deliberation, the name and constitution of the body was amended to make membership available to the petroleum industry as a whole. The widened scope was indicated by the new name—The Institute of Petroleum—and the salesman and the accountant, the economist and the operator, and all those engaged in the petroleum and allied industries were brought within its purview.

Membership

Membership is open to all persons or companies engaged in the petroleum or allied industries, the term "allied industry" being interpreted on a very broad basis.

In either class the minimum age is 30 years, and a candidate for Membership must have the requisite position and attainments, including at least five years in a position of superior responsibility in the petroleum or allied industries. For the Fellowship, the candidate must have suitable scientific or technological attainments and five years superior responsibility in the domain of the science and technology of petroleum.

Those with a minimum of two years experience are eligible for the grade of Associate Member or Associate Fellow, the minimum age for these classes being 23 years. The Student membership class provides for those who are studying petroleum, and companies engaged in the industry and wishing to support the work of the Institute may become Member-Companies.

Organization

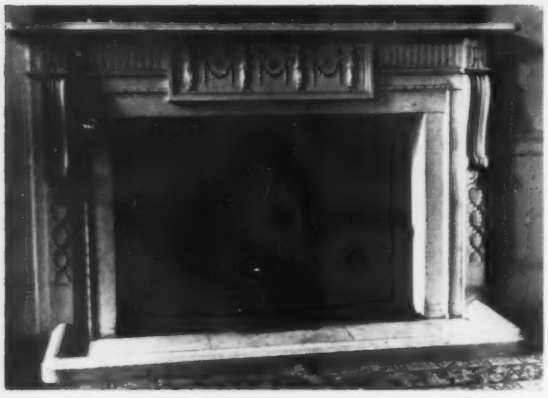
Control of the Institute is by its Council, a body elected by ballot of the members and functioning through a number of committees appointed to conduct its specialized activities. Honorary officers comprise the President, the Honorary Treasurer, and Honorary Secretary, and the permanent staff consists of the General Secretary, who is responsible for general administration, the Editor, who handles the publishing side of the Institute's work, and a Technical Assistant, whose main concern is to look after the activities of the committees dealing with standardization, engineering, and research.

The IP also has branches in various provincial centres in the U.K., in Trinidad, and in the Persian Gulf. There is also a special discussion group concerned with the economics and operations sides of the industry.

Publications

The most important function of the IP has been that included in its objects as "the dissemination of information". The first step in this direction was the decision in 1914 to publish a *Journal*, in which would be recorded the papers read and discussed at meetings of the Institution and also contributions of a scientific character. The *Journal* was first published quarterly, and since 1931 has been a regular monthly publication.

The crest of the Institute is described in Letters Patent granting the use of Armorial Bearings as "an Archaeopteryx displayed Gules". The use of the Archaeopteryx was suggested by a Member of Council and the design of the crest worked out by the College of Heralds. The signatures on the official document shown above are of Sir Algar Henry Stafford, K.C.V.O., C.B., M.C., Garter Principal King of Arms; Sir Arthur William Steuart Cochrane, K.C.V.O., Clarenceux King of Arms; and Sir Gerald Woods Wollaston, K.C.B., K.C.V.O., Norroy and Ulster King of Arms.



The Institute's offices in Portland Place, London, are located in a house designed and built by John Adam in the pre-Regency period. He was noted for his fireplaces, one of which is seen above, and—

With the change in outlook and name and particularly in the period immediately after the second world war, it was realized that there was a need for a second periodical to cater for the needs of the growing body of members. To meet these requirements the *IP Review* was introduced in 1947 and quickly established its position as a medium for keeping members informed both on matters of topical interest and on current technical and economic subjects.

In addition to its periodical publications, the Institute has a fine record of book publications to its credit. Perhaps the most important of these publications is "Standard Methods for Testing Petroleum and Its Products", about which more will be said later. Another important book is "Modern Petroleum Technology", the second edition of which has recently appeared. This publication surveys the technical side of the petroleum industry and has proved itself to be of value not only to the student, but to many others in the industry.

During 1949 and 1950 a series of articles on the significance to be attached to the properties of petroleum products as revealed by chemical and physical tests was published in the *IP Review*. These articles have now been made available as a separate booklet under the title "Significance of Properties of Petroleum Products".

The other book publications of the IP are concerned mainly with some special activity, and will, therefore, be referred to under their appropriate heading.

Library

The Library of the Institute occupies the largest room in the Institute premises, this room also serving as a reading and writing room for members. The Library contains the principal text books and similar works relating to the petroleum industry, and long or complete runs of the leading periodicals concerned with petroleum and allied industries. The Library forms a convenient centre for petroleum literature, and members of the Institute who are resident in the United Kingdom have the privilege of obtaining books on loan.

Standardization

Since 1924 the Institute has been the recognized authority in the United Kingdom for the promulgation of standard testing methods for use in the petroleum industry. In that year the first edition of "Standard Methods for Testing Petroleum and Its Products", a slim volume of 100 pages containing details of 39 test methods, was published. In January 1955, this volume reached its 14th edition and contained details of 121 methods in its 688 pages. Simultaneously, a supplementary volume of 84 pages was necessary to detail the five IP engine test methods for the knock-rating of aviation and motor fuels and the diesel fuel ignition quality method which had previously appeared in the main book.

In the field of standardization, the Institute has been active in regard to the international aspects of standardization and in collaboration with the ASTM has made considerable contributions to this work. Agreement between the two bodies has been reached in respect of a large number of test methods and many of these are accepted as standard throughout the world. The IP is also co-operating with standardizing bodies in Belgium, France and Holland.

Oil Measurement

A particularly important piece of IP/ASTM co-operation resulted in the publication in 1952 and 1953 of a trilogy of volumes under the title of ASTM/IP Petroleum Measurement Tables. The British and Metric editions, with 416 and 452 pages respectively, were issued by the IP, and the American edition (525 pages) by the ASTM, both bodies being jointly concerned in the design and calculation of the 39 tables which cover every type of computation of quantities of petroleum throughout the world.

Meetings and Congresses

The parent body holds regular meetings in London at least once a month during the session September to May, while the various Branches and the Economics and Operations Group also meet at frequent intervals in their various spheres. At all these meetings, papers are read and discussed and are generally published either in the *Journal* or in the *IP Review*.

Since the second world war, three very successful Summer Meetings have been organized. The first, in 1952 at Hastings had for its theme "Oil—the task ahead"; the second, at Buxton in 1953 discussed "The post-war expansion of the U.K. petroleum industry", and at Llandudno last year the subject was "The role of petroleum in modern transport". The papers and discussions at the last two meetings are available in book form and are valuable contributions to petroleum literature.

In 1933 the First World Petroleum Congress was organized by the Institute and held in London. Attended by over 1000 delegates from almost every country of the world, this World Petroleum Congress was the forerunner of two further successful congresses (held in Paris in 1938 and in The Hague in 1951) and the Fourth Congress which is being held in Rome in June of this year promises to be as successful as its predecessors. The Secretariat of the Permanent Council of the World Petroleum Congress is located at the Institute's headquarters in London.

—his ceilings. This picture shows part of the Library ceiling.

Two international conferences on oil shale have been arranged by the Institute, the first in 1938 and the second in 1950. Both were instrumental in bringing together the leading authorities on the subject of oil shale and shale oil treatment and utilization. They were held in Glasgow, in close proximity to the Scottish shale fields, and the volume of proceedings of the second event is the most comprehensive treatise on oil shale.

Conferences on specialized subjects have also been organized by the Institute, examples being one on mass spectrometry in Manchester in 1950, one on the application of mass spectrometry in London in 1953, and another on molecular spectroscopy in 1954. The proceedings of these conferences have done much to advance the knowledge of the matters under discussion and the printed reports are valuable contributions to the literature.

Safety Codes

The Engineering Committee has been charged by the Council with the task of preparing an IP code of safe practice to cover all operations in the petroleum industry. So far two such codes have been prepared and published. The first covers electrical equipment and installations, and the second deals with safety measures to be observed in marketing operations. Two other codes in the series are being prepared for refining and for production operations.

Awards

Premier award of the Institute is the Redwood Medal established in 1921 in honour of the Founder-President, Sir Boverton Redwood. It is awarded "as and when desirable, but not more than once in each year, to a petroleum technologist of outstanding eminence".

The Eastlake Medal, inaugurated in 1953 in recognition of the work of Arthur W. Eastlake in the formation and advancement of the Institute, is awarded "for long and meritorious service to the Institute".

The Library of the Institute contains the leading works on petroleum and one of the best collections of periodical petroleum literature in the U.K. Part of the periodical shelves are pictured above.

Persons of eminence or of exceptional scientific attainments may be elected as Honorary Fellows, and persons of eminence, whether or not engaged in the petroleum industry, or the occupant of some particular official position, may be elected as Honorary Members or Honorary Fellows.

The Institute is also the Trustee of the Cadman Memorial Fund, contributed by the Anglo-Iranian Oil Co. Ltd. (now British Petroleum Co. Ltd.) to commemorate the work of the late Lord Cadman. The fund provides for a Cadman Memorial Lecture to be given at least once every three years, the lecturer to receive a medal.

★ ★ ★

Recent Italian Oil Developments

Early in 1955 Petrosud S.A. reported the discovery of oil in its Cigno No. 1 well, about 26 km inland from Pescara. Depth of the oil was 776 m (2545 ft) and it was anticipated that settled production would be about 2000 b.d. of water-free 34 API (0·8550 sp. gr.).

Petrosud S.A., on whose exploration concession known as Abruzzi the well is located, is an Italian company jointly owned by Montecatini, the Italian chemical group, and American International Fuel and Petroleum Co., a subsidiary of Gulf Oil Corporation.

In October 1953 Petrosud was successful in finding oil at Ragusa, in Sicily, at a depth of nearly 7000 ft. It is understood that eventually sixteen wells will be drilled in Ragusa and a further six wells in neighbouring areas. Already four wells have been completed at Ragusa and a fifth is in process of being drilled.

Cigno No. 1, the Petrosud S.A. well in the Pescara region—

—and the first flow of dirty oil being blown out.

Around the Branches

FAWLEY, BAHRAIN, KUWAIT, LONDON, NORTHERN, SCOTTISH, SOUTH EASTERN, SOUTH WALES, STANLOW, TRINIDAD

Bahrain Branch

The first annual general meeting of this newly-formed Branch was held on 6 February at Awali Theatre. Twenty-three members were present, including eight from Qatar, and the chair was taken by W. H. Cotter.

This meeting marked the formation of the Bahrain Branch as a separate Branch of the Institute after functioning for almost three years as a sub-area of the Persian Gulf Branch. Mr Cotter outlined the events that had resulted in the formation of the separate Kuwait and Bahrain Branches and surveyed the eleven meetings which had been held in the Bahrain sub-area during the past year.

H. G. Spence, (honorary secretary) and W. H. Carter (chairman)

The election of a new committee completed the agenda.

Visit of Qatar Members

Institute of Petroleum members from Qatar visited the installations of the Bahrain Petroleum Company on the morning of 11 February, on the invitation of the Company's general manager, C. R. Barkhurst. After the tour the visitors were entertained to lunch in Al Dar.

London Branch

On 17 February at the invitation of Shell-Mex and B.P. the London Branch attended a film show held in the Mezzanine Cinema at Shell-Mex House.

The programme was selected to show the broad interest of the oil industry in this medium. The films ranged from *Forest Heritage*, a purely "interest film" portraying life in the rural surroundings of the New Forest, to technical and training films designed primarily to instruct company personnel. Also included in the programme was the 1953 *Nurburgring Grand Prix* and a colour cartoon, *Power to Fly*.

The Branch's appreciation for the arrangements made by Shell-Mex and B.P. to entertain members and their guests was expressed by the Chairman, W. D. Davies.

Oil Additions

N. E. F. Hitchcock's paper, "Oil Additives—Their Function Explained", which had to be postponed from the original date of 23 February, was presented on 2 March.

Mr Hitchcock illustrated his lecture with a number of interesting bench experiments designed to show the function of chemical additives in lubricating oils. For example, detergency was shown by centrifuging two oils, only one of which contained additive, equal amounts of carbon having been added to both oils. The oil containing the detergent additive did not precipitate the carbon under centrifuging, whereas the untreated oil did. The influence of antioxidants, bearing corrosion inhibitors, pour-point depressants, tackiness additives, etc., was also illustrated and the experimental results shown by use of an epidiascope.

Following the talk an interesting discussion was held under the Chairmanship of A. C. Mauchan.

A vote of thanks proposed by G. M. Barrett was approved by the large attendance of members and visitors.

The annual general meeting of the Branch followed the discussion on Mr Hitchcock's paper.

Scottish Branch

A meeting of the Branch was held in the recreation hall of Grangemouth refinery on 10 March, when Professor H. B. Nisbet presided.

Professor Nisbet announced that the following office-bearers had been elected for the session 1955-6: chairman, J. M. Caldwell, J.P.; vice-chairman, Professor H. B. Nisbet, Ph.D., D.Sc.; secretary, W. Stirling; treasurer, Dr G. H. Smith, M.C.

Introducing the speaker, Lt-Col S. J. M. Auld, O.B.E., M.C., D.Sc., President of the Institute, Professor Nisbet referred to the honour conferred on the Branch by this visit from the President and recalled the fact that Colonel Auld had addressed the Scottish Branch just after its inauguration in 1939.

The President spoke on the "Internationalization of Petroleum Knowledge" and was accorded a very hearty vote of thanks at the close of his address.

South Eastern Branch

A meeting was held at the King's Head Hotel, Rochester, on 8 March. Owing to cancellation the lecture which should have taken place was replaced by a film show.

Combined Operations showed the building of the reinforced concrete water intake chamber for Coryton refinery. Then from water the emphasis changed to the air with *Turbo-Jet Propulsion* and *Speedbird to Sunrise*, the latter, with sun-drenched scenes of Eastern places, contrasting vividly with the cold outside.

The Nature of Plastics, which followed, gave a picture of the building up of one type of plastic material, and was particularly instructive.

Humour was afforded by the safety film *The Wise Man and the Foolish*, taken in a Middle-East refinery, the principal characters being two "new intakes", both natural comedians. In lighter vein still the clock was put back by a reissue of an original Charlie Chaplin film—*In the Bank*.

The attendance, of about fifty members and their guests, was excellent in view of the hard weather.

The Empire That Was Rome

By **D. A. HOUGH**

All over the world there are monuments in stone, raised to the glory of some forgotten god or once mighty ruler, and travellers from many lands have written of the magnificent architecture of Greece, the antiquities of Egypt, the pageantry of the English castles, and the ruined temples of Carthage. But only in Italy are all these things to be found together in one country.

It is indeed an embarrassing choice for the traveller with only a week or two to spend. In the south there is Naples with its matchless blue harbour, and the old Roman city of Pompeii. Buried for nearly 2000 years under the rain of lava from Vesuvius, Pompeii stands again seemingly untouched—a ghost city in which so little imagination is needed to see the Roman centurion unhitching his chariot horses from the stone bridle posts which barred his vehicle's entry to the Forum.

Then up towards the north, in a countryside of vineyards and stately villas, is the mediaeval town of Florence, with its glorious architecture and art galleries. For hundreds of years it was the home of the Medicis, and outside the old walls the Arno river is spanned by the lovely Ponte Vecchio, lined by the shops of the Florentine goldsmiths and silversmiths.

Further to the east there is the romantic city of Venice, with its canals and gondolas and countless bridges, and further north still, Milan, famous throughout the world for its opera house.

Numerous smaller towns such as Pisa, where the famous leaning tower is situated, and Assisi, where St. Francis was born, offer irresistible attraction to the visitor in Italy. But the Organizing Committee of the Congress, in its infinite wisdom, has chosen Rome as the Congress centre; and only in Rome are the glories of all the past ages gathered together for the traveller's delight.

The Legend of Rome

The origin of Rome—the Eternal City—is lost in the legends of the past. Many are the stories that are told of its foundation, some of them prosaic, some highly romantic, but the most widely accepted legend, from which Rome takes her crest, is that of Romulus and Remus.

Their mother, so the legend tells, was Sylvia, the daughter of Numitor, King of Alba. Numitor was banished from his kingdom by the first recorded wicked uncle, Amulius, and Sylvia was forced to become a Priestess of Vesta, which meant that she could not marry and consequently could not bear an heir to the throne. But the god, Mars, drawn down to earth by her beauty, fell in love with her and she bore him twin sons, Romulus and Remus. Amulius, fearful of the rightful heir, ordered the children to be thrown into the Tiber. The order was obeyed, but their basket cradle floated down the river, and they were found and suckled by a she-wolf, before being rescued and cared for by a shepherd. He raised them to manhood and then told them the story of their birth. Crying aloud for vengeance, they ran through the countryside inflaming the populace against their tyrant uncle, drove him from the country, and reinstated Numitor on the throne.

The tranquil ruins of the Forum Romanum.

The legend tells us that to celebrate the liberation of their country, the two brothers decided to build a city; but, as so often happens in peace, the allies in adversity quarrelled. Romulus wanted to build his city on the Palatine Hill overlooking the Tiber, Remus argued for the Aventine Hill, and in a sudden fit of temper, Romulus slew his brother.

How much of the story is legend and how much, if any, is truth is very uncertain, but there was a King Romulus and he lived and ruled Rome some seven centuries before the birth of Christ.

It is not until 390 B.C., after the city had been sacked by the Gauls, that the recorded history of Rome begins, but from then until A.D. 476 minutely detailed chronicles record the golden age and final fall of the Roman Empire. They chronicle the brilliant, glittering figures that made Rome the greatest power the world had ever seen, not only in military conquest, but in learning, architecture, sculpture, and law-giving. It is the wonder of modern Rome that so much that recalls the spirit and the figures of those times, still lives to move the imagination.

The Historic Monuments of Rome

The old walled city of Rome, that was destined to grow into an Empire, was built on seven hills, the Palatine, Capitoline, Aventine, Quirinal, Virrinal, Esquiline, and Caelian. Four of the ancient bridges used in the times of the Caesars remain to this day, and many monuments of stone still stand to tell the story of that golden era.

One of the greatest of the remains is the Forum Romanum lying at the foot of the Palatine Hill and named by the Emperor Augustus. The old Roman Forum was a square or paved open place, lined by important public buildings and temples. The Forums were used for popular assemblies and proclamations, sometimes even for burning dead bodies. The sale of goods in open market took place in them, and Augustus erected awnings to shade the passers-by.

The remains of the baths built by Caracalla.

The Emperor Augustus was one of the greatest of the Roman Emperors, and in 29 B.C., two years after his shattering victory at Actium, the Forum Romanum resounded to the glittering pomp of his Triple Triumph. There behind the conqueror came the train of Gallic and Illyrian captives, dragged by the chariots of the Roman Legions. There, too, across the Forum marched the Asiatic potentates and the two children of Cleopatra of Egypt—the last of the Ptolemies.

It was not only in the military field that Augustus won fame. He was the supreme ruler of the Empire, indeed, almost of the whole Western world, but he used his power more wisely than almost any other Roman ruler. He consolidated the Empire and gave it peace, he reformed the systems of the state government, and began the gradual absorption of the various semi-autonomous cities and states into the Roman Empire. He was one of the great patrons of the arts, and Vergil and Horace were only two of the many poets who flourished in his reign. By the time of his death in A.D. 14 he was worshipped as a god in many parts of the Empire, and with him died the first golden age of Rome.

In A.D. 68 Nero, who by extravagance, cowardice, and debauchery had almost brought the Empire down in ruins, was deposed and killed and his place taken by Galba. He ruled for two uneasy years, and then, losing the confidence of the Legions, he was attacked by the mob whilst sacrificing in the temple on the Palatine, dragged into the Forum Romanum, and stabbed to death.

Within the ruins of the Forum still stand many buildings, columns, and statues; many have fallen into decay, in some cases only the foundation stones mark the site of what was long ago a sacred temple of the Roman gods, or a triumphal arch to an emperor. But here and there a building still stands to testify to the splendour and grandeur that was once the Forum Romanum.

One of these is the magnificent ruined Basilica Aemiliana and another the Arch of Septimus Severus. The reign of the Emperor Severus marked a new epoch in Roman rule. He won his title in A.D. 193 through support of the Legions, and with the aid of the Legions he ruled the Empire like a dictator. More than any emperor he broke the power of the Senate, and although he brought peace after a long period of civil war, his merciless revenge on all who opposed him paved the way to a long period of military dictatorship.

Another great Forum is the Forum Trajan. It was built between A.D. 93 and 113 by the Emperor Trajan to surpass in size and magnificence anything built by his predecessors. The feature of the remains of this great plateau is the statue of Trajan, mounted on a superb stone column. Trajan was almost one of the greatest of the emperors, but brilliant soldier and statesman though he was, he never conquered his mania for superlative and sometimes superhuman achievement. The wonderful bas-reliefs on the foot of his column tell the story of his greatness.

In A.D. 105 he declared war on the Dacians beyond the Danube. In one relief he is seen receiving homage during his forced marches, in another relieving the hard-pressed Roman garrison of a Dacian town. Different panels show his strategy of independent columns converging on the Dacian capital, leaders of the defenders committing suicide by poison, the enemy hunted like animals through the forests, and Decebalus, their leader, plunging his sword into his own throat rather than be dragged through the Forum in a Roman Triumph. Trajan held a Triumph, in fact one of the most magnificent ever held, when he returned to Rome, and thousands of gladiators are said to have fought in the arena during the victory celebration.

But his overwhelming lust for power and glory broke him in the end, and nearly broke the power of Rome. He extended the sovereignty of the Empire through Albania and Armenia, he conquered Syria and Babylon, and drove King Chosroes of Persia into exile. But these conquests had stretched the might of Rome beyond its strength, and a series of rebellions in A.D. 117, from Britain to Mesopotamia, brought death to Trajan and near disaster to the Empire.

On the right bank of the Tiber stands the mausoleum of the Emperor Hadrian, converted in the Middle Ages into the Castle of St. Angelo. Hadrian succeeded Trajan, and under his rule the power of Rome reached its zenith. He was the greatest of all the Roman Emperors. A magnificent soldier, he was also a man of letters and a patron of the arts. He had a passion for building, and in his time baths, temples, libraries, and porticoes were built all over the Empire.

As a soldier he rebuilt the Legions to a new pattern, and devised a revolutionary defensive system of stone forts linked by a continuous wall, defended by mobile columns based on the forts. A striking example of this system is Hadrian's Wall from the Tyne to the Solway, built after the 9th Legion had been massacred in York.

After building up the finances of the State, so depleted by Trajan, to a hitherto unknown prosperity, and re-modelling the Civil Service, Hadrian consolidated the frontiers of his Empire and put down rebellions in Britain and on the Danube. In A.D. 132 he marched to Jerusalem to quell a revolt by the Jews, and banished them from Palestine.

The great Emperor's last years were spent in much suffering from an incurable illness, and on his deathbed on 10 July, A.D. 138, surrounded by his household, he whispered aloud as he died:—

"Tell me, sweet flitting soul, I pray,
Guest and companion of my clay,
Whither away, whither away?
So pale, so stiff, so bare today,
Never to play, never to play?"

There are many triumphal arches in the old city, raised as a lasting monument to the greatness of the Emperors whose names they bear, and still portraying in carving and sculpture the scenes and triumphs of their lives. One of these is the Arch of Titus, that stands, hardly touched by the centuries, close to the Colosseum.

Titus reigned for only two years, but in that time he earned a popularity with the Roman people unsurpassed by any Emperor. He was a magnificently handsome man and a flamboyant personality. As a commander in the East he fell in love with a Jewish Princess, Berenice, and brought her to Rome as his mistress, but when he had to choose between love and being a Caesar, he chose without hesitation the Emperor's purple. One of his first acts was to build a People's Palace, where he bathed in the presence of his subjects—an unheard of thing for a Caesar to do. But the greatest monument to this spectacular Emperor is the Colosseum, the world-famous amphitheatre which he built in A.D. 80, where he once staged an astonishing festival of gladiatorial contests, sea fights—for which the arena was flooded—and wild beast hunts that lasted for a hundred days. It is said that ten thousand gladiators fought in the arena during this festival.

The Colosseum, perhaps more than any other monument of the days of the old Roman Empire, seizes the imagination and conjures up so vividly the impression of the cruelty and excitement and splendour that has come down to us over the centuries as the true epitaph of the Roman Age. Barbaric and cruel times they certainly were, yet there was splendour too; and it would be a person of little imagination who could stand in the quiet ruins of this gigantic stadium, and not see it once again filled to the topmost terraces with screaming, blood-hungry Romans. The citizens filling the great stone galleries; the nobles and their ladies, clothed in flowing robes of every colour, in their private boxes; the silent white-clad Vestal virgins on their heavily guarded terrace, and sitting aloof in the Royal Gallery, the great Emperor Titus clothed in his purple toga and surrounded by his Imperial Bodyguard. All of them from patrician to slave, roaring and screaming as down in the arena the naked Retiarius tried to enmesh the heavily armed and armoured Secutor in his net, before finishing him with his trident.

Standing, in the twentieth century, among the tranquil ruins of massive stone, there is no need for a guide book or a guide to help to recreate the scenes of cruelty and courage that took place under the burning summer sun, so many centuries ago.

In the latter days of the Roman Empire the rule of the Caesars became so feeble and degenerate that one after another the Roman provinces crumbled before the onslaughts of the fierce tribes of Central Europe, and finally in A.D. 476 the barbarian hordes of Goths, Vandals, Franks, and Visgoths poured over Italy, and the Roman Empire was submerged for ever.

For hundreds of years Italy became a country of small city states, and indeed it was not until the nineteenth century that Garibaldi launched his famous campaigns that culminated in the foundation of modern Italy.

Strangely enough, although Rome dwindled in the fifth century to the tiny area enclosed by the city, as the centuries passed she rose once again to be the mother city of a different kind of Empire. The new religion of Christianity had spread outwards from Palestine during the first and second centuries A.D., and in the fourth century Christianity became the official Roman religion under the Emperor Constantine. After St. Paul and St. Peter were martyred in Rome, the city became the home of the mother church of Christianity, and since the breakaway of the Greek Church in the ninth century and the Protestant Church in the sixteenth century, it has been the centre of the Roman Catholic Church.

In 1506 Pope Julius II commenced, on the supposed site

The Colosseum seen through the triumphal arch of the Emperor Titus

of St. Peter's crucifixion, the enormous building of St. Peter's Cathedral. It took 176 years to complete and the great dome rises over 400 feet above the floor. The tomb of St. Peter lies beneath this dome.

Hidden away in one of the side aisles of St. Peter's is a tomb of considerable interest to British visitors. Here the last hopes of the House of Stuart, the Old and Young Pretenders, lie buried.

It is doubtful whether visitors to the Congress could see all the historical treasures of Rome in the nine days of its duration. The museums and art galleries alone would take that time, and examples of the work of almost every great sculptor and painter can be seen in these galleries.

If it is opened to Congress members, the Vatican is one building that must not be missed. This is a superb building, containing over a thousand rooms, eight grand staircases, and a wonderful collection of sculpture, pictures, and Roman remains.

There are several magnificent examples of Roman baths in the city, and the Bath of Caracalla, built by the Emperor Caracalla in A.D. 210, is a particularly fine example. These public baths were open to all Roman citizens for a small fee, and were the centre of the intellectual life of the city.

Of churches and monuments there are literally hundreds. The Church of St. Maria built in the twelfth century, and the Church of St. Pietro built in the fifteenth century, the latter with a fine panoramic view of Rome, are well worth a visit, as is the Pantheon erected by Agrippa in 27 B.C. and restored by the Emperor Hadrian in the second century. The building was consecrated as the Church of St. Maria ad Martyres in 609 and is one of the best preserved buildings in the city.

Some of the finest Roman remains can be seen in the Capitoline Museum, and another romantic corner is the Palazzo del Senatore, near the Roman Forum. This twelfth-century building was erected on the site of the old Roman Tabularium, and below it are the ruins of the temples of Concord, Vesparian, and Saturn. The old walls of the city, of which a considerable portion still remain, are 1600 years old.

The English poet, Shelley, once wrote of a broken statue in another land:—

> "And on the Pedestal these words appear
> My name is Ozymandius, King of Kings,
> Look on my works ye Mighty, and despair!
> Nothing beside remains. Round the decay
> Of that colossal wreck, boundless and bare,
> The lone and level sands stretch far away."

The epitaphs the Caesars wrote in stone have survived the centuries; and the story of their greatness and splendour, so inextricably mixed with cruelty and avarice—which in the end brought the Roman Empire to ruin—will live for ever.

★ ★ ★

The Visitor in Rome

Not very long after the liberation of Rome in 1944, I arrived at a rest camp on the outskirts of the city for six days leave, and found there a Padre from my own Division, also on leave, who had spent some two years studying in Rome before the outbreak of war.

We came to a very amicable arrangement regarding my jeep, my petrol (to say nothing of my conscience), and his truly remarkable knowledge of the churches and ancient monuments, and for six wonderful days we careered about the city from breakfast to dinner and saw, I suppose, about one quarter of all the magnificence and beauty that genius, antiquity and Christian faith have bequeathed to Rome.

There is certainly a great deal to explore and I do not want to pose in any way as an expert on the city; indeed as an explorer I am very much in the amateur class. Nevertheless as one who has attempted the impossible under the most favourable conditions and with a really first-class guide, I thought if I listed very briefly some of the things that have given me especial pleasure, it might perhaps be of some assistance to those who have never been to Rome before, and have perhaps only a few days to spare in which to pick out some of the particularly beautiful and interesting scenes from amongst the almost innumerable picturesque and lovely places there are to see, that are so minutely described in the guide books.

Although it is rather tempting to lay out little itineraries covering two or three streets at a time, I doubt if this is really a good way to do it as there are so many things that you just must see. If you prefer the itinerary way, and have the time to spare, the guide books do it professionally.

Fortunately Rome is a comparatively small city and pretty nearly all the places of great interest lie within a two-mile radius of the Colosseum, and a large part of the remains of the old Roman Empire lie within half a mile of it. I remember we found mixing the very old with the more "modern" art of the Middle Ages was a satisfactory and strangely instructive way of doing it.

To anyone who has flown over for three days at the Congress, and has exactly one hour to spare before taking off for the return journey, I would suggest he visits the Colosseum—because this is the great symbol of the Roman way of life, left behind for us by the first and last rulers of the world, or at least the world as they knew it then, and there is nothing quite like it anywhere else on earth. If you can manage two hours then I can only suggest St Peter's, with its tremendous size and impressive approach over the great stone-flagged square. There are pamphlets by the hundred to describe its history, and if you can merely manage to see just these two tremendous monuments of two such different civilizations, then at least you have caught a glimpse of the true spirit of Rome. For the visitor with nearly a fortnight to spend in Rome, however broken up the days may be, there is so very much more to see. First and foremost, because it covers in some way every age of Rome, there is the Vatican City. Unfortunately I do not know at this stage what arrangements have been made for Congress members to see the Vatican City, although the IP Bureau will have full information at the Congress, but if it is possible then I can only implore you not to miss the opportunity of seeing this fabulous place. Parts of it, however, are always open, and in particular the wealth of art treasures of every description packed into the thousand-room Palazzo Apostolico are quite unique in the world. Here is the famous Sistine Chapel—one of the greatest monuments to the genius of Michelangelo, the incredible library, which is quite beyond my powers of description, the magnificent Pio-Clementino Museum near the ornate Royal Stairway, and the famous Vatican Garden—certainly not the least beautiful sight in this city within a city.

Another palace you ought to see is the fifteenth-century Palazzo Venezia in the Piazza Venezia. It was from the

balcony of this palace that Mussolini addressed the crowds. The building is now a museum, and when I was there it housed a very fine collection of Italian armour. In the same square is the incredibly ornate Mausoleum of Vittorio-Emanuele. Even if you do not like it you really ought to see it, and if you can summon the strength in an Italian June to climb to the top of the Monument, you will be rewarded with a superb panoramic view of Rome.

Of churches to see it is indeed hard to suggest a choice. I seem to remember reading somewhere that there were over eight hundred. Whether or not this is true, there are certainly a great many more than in any city I have ever visited. A large number of them are very old and some date back to the very dawn of Christianity.

visiting is the Santa Maria del Popolo, near the Porta del Popolo, supposedly built on the site of Nero's grave; it is a particularly beautiful building and it also has the advantage of being near the gate leading to the Villa Borghese. This is an enchanting spot and if you like your sightseeing in small easy stages, I can recommend after a late morning start that you look over the church, pause for elevenses, and then stroll through the lovely gardens and woods of the Villa to see the art gallery, which is one of the finest in Rome.

I think you ought to see the Trinita dei Monti Church, in its wonderful setting in the Piazza di Spagna, and also the very old church of S. Giovanni-dei-Fiorentini in the Via Giulia.

One church that particularly stands out in my memory is

The interior of the Vatican

I have no doubt at all that there are a great many fascinating and famous old churches not in my list, and of which I regret to say I have no knowledge, but for those who particularly like exploring old churches there are admirable guide books which give the fullest details of all of them. Here are merely a few that I have visited, and all I can claim is that they are exquisitely beautiful, and at least give a glimpse of every type of Italian architecture and decoration over the past fifteen hundred years.

One of the very early churches built in Rome, dating back to the late fourth century, is San Marcello. Legend has it that this is the site where the Emperor Maxentinus forced Pope Marcellus to tend his horse. It is in the Corso Vittorio and very near to it is the curious Church of Santa Maria, which is heavily baroque on the outside and purple jasper on the inside.

A fifteenth-century church that I think you would enjoy

Stefano Rotondo, in the road of that name. The building was originally a market in the days of Nero, but the thing I particularly remember was a series of horrific frescoes of martyrs being gruesomely put to death. Other very old churches dating back to the fifth and sixth centuries are Santa Sabina in the street of the same name, San Lorenzo in Lucina in the piazza of that name, and the fifth-century Basilica Eudoxia in the Piazza di San Pietro in Vincoli, in which are the chains which bound St Peter, and the glorious Moses of Michelangelo.

There are innumerable other wonderful churches and basilicas, but from personal knowledge I can mention only three; Santi Quattro Coronati, in the Via dei Querceti, has a timeless tranquillity that makes a mockery of any prior intention to hurry one's visit. It is a fourth-century church, extremely beautiful, with some splendid frescoes of Constantine in the Chapel. Then there is the very interesting mediaeval

church of Santa Maria in Cosmedin in the Piazza Bocca della Verita, which has a huge stone face under the portico and a legend that if you thrust your hand into its mouth and told a lie, your hand was bitten off! I believe this portico was featured in the recent film *Roman Holiday*.

Lastly, there is one more church which I think you will find very interesting, and that is Santi Giovanni and Paulo in its peaceful backwater near the Palatine. It is one of the very oldest in Rome and deep underground there is a wonderful two-storey Roman house with some superb frescoes and carved figures.

There is a considerable number of galleries and museums housing some of the greatest art treasures in the world, and art lovers will find the guide books give a tremendous amount of detail. If, however, you have not the time to do very much in this line, but would like to see a bit of everything, I would suggest you try the Pinacoteca in the Viale Vaticano, because this magnificent gallery is connected to the Vatican Museum, which is one of the finest in the world.

It would be a pity to miss the Castel Sant' Angelo, the wonderful mausoleum of the Emperor Hadrian—surely the greatest of all the Roman Emperors, and if you like something macabre, visit one of the great catacombs out on the old Appian Way. These are long, black tunnels cut into the cliff and lined with the bones of the early Christian martyrs.

Now to the monuments, temples, and forums of ancient Rome. Wonderful and exciting though the renaissance period of Italian art may be, many examples of it have spread throughout the world. The remains of the old Roman civilization are unique; and, for me at least, they are completely irresistible.

In the main they lie within half a mile of the Colosseum and the guide books describe them minutely. The most important of the remains are the five Forums—The Roman, Augustus', Caesar's, The Imperial, and Trajan's—and The Palatine Hill, the birthplace of Rome. The House of Livia, where Augustus once lived, is perched on the slopes of the Palatine and the Palace of the Flavians stands close by. The Antiquarium of the Palatine, where many of the Roman finds are displayed, is also very well worth a visit. Across the way from the Palatine rises the Capitol, crowned by the two palaces designed by Michelangelo. One of these is the Capitoline Museum housing a glorious collection of classical statues, and on the highest point of all stands the oldest church in Rome—Santa Maria in Aracoeli. Not very far away are the impressive ruins of the Baths of Caracalla in the Viale Guido Baccelli, and all around this area of the Capitol and the Forums rise the triumphal Arches of the Caesars. In fact within this area lies almost everything that remains of the greatness of the once-mighty Roman Empire.

It is not very big and it is all most conveniently adjacent, but once you start looking you will find you want to walk more and more slowly, and I can only say that after six full days of looking I had still not managed the time to set foot in the Capitol!

Sightseeing in Rome, breath-taking and exciting though it is, can be pretty exhausting and thirsty work, and to be really helpful to members I ought to be able to produce addresses of cheap but charming little restaurants, smothered in creeper and hundreds of years old, set at all the key points of the city. That, alas, is completely beyond me, but I can say that there are a considerable number of fascinating little restaurants (particularly on the Quirinal) which serve very reasonably-priced Italian dishes. But food is not cheap these days in Rome, and if you want "Rossbeef" (which seems to cover the entire cow!) you have to pay for it. There are probably a hundred magnificent restaurants of which I have never even heard, but with great temerity here are a few that I know of that I think you will like.

In the luxury group, the terrace of the Casina Valadier, in the Pincio Gardens, is a wonderful setting for a first-class meal, and if you do decide on a morning at the Villa Borghese after looking at Santa Maria del Popolo, then luncheon at the Casina delle Rose in the Villa gardens will complete a delightful little excursion. If you are near the Roman City around lunchtime, the Basilica Ulpia, overlooking Trajan's Forum is another delightful restaurant.

A very good, but less expensive, small restaurant near the Old City is the ancient San Carlo in the Corso, and the Bolognese in the Piazzo du Popolo is not far away.

If you like trying local dishes, the Umberto, in the Pizzale Flaminio, does some fascinating things with spaghetti, and there is a restaurant in the Piazza Pietra, whose name I am afraid escapes me, which specializes in fish dishes. Outsize steaks can be had at the famous Buco near the Collegio Romano, and if you like your restaurants hundreds of years old try the Fedelinaro in the Piazza di Trevi.

If it is hot in June and you feel a small dinner party somewhere in the cool of the countryside would be a pleasant way of ending the day, I have heard that either the beautiful Faro Restaurant on Monte Mario, or the Sora Pia at Madonna del Riposa are extremely good; but from personal knowledge I would suggest that for a special dinner party, you should try the quite fabulous Villa Palazzi, not far from the Congress Centre. This was the villa that Mussolini built for Carla Petacci, and I can only say that never in my life have I seen a restaurant like it. It is far from cheap—but I can assure you it is different!

I hope these random suggestions may be of some help to those seeing Rome for the first time. It is a glorious city and there is nothing quite like it anywhere else on earth—but as a whisper to the wives of those conscientious oilmen who intend to brave the heat of Naples for the Oil Equipment Exhibition—to me, Pompeii is the eighth wonder of the world!

D.A.H.

★ ★ ★

Petroleum in Parliament

U.K. Generating Capacity

In answer to a question in the House, the Minister of Fuel and Power gave the following details regarding the total installed capacity of electric power in Great Britain.

"At 31 December 1954, there were 21,822 megawatts installed in publicly-owned power stations in Great Britain and it is estimated that there were 2800 megawatts of private plant. Of the publicly-owned plant 20,986 megawatts is at present coal-fired, 220 megawatts oil-fired, and 606 megawatts water-powered. There were also 10 megawatts operated by waste heat. Details of private plant are not available".

New Fuel Research Station

A site has been chosen for a new DSIR fuel research station at Stevenage. Specifications for the first buildings have been drawn up and are now being considered by the Ministry of Works which will prepare sketch plans and estimates. This news was given by the Parliamentary Secretary to the Ministry of Works in answer to a recent question in the House.

The Technical Sessions of the Fourth World Petroleum Congress

A Review of Subjects to be discussed in each Section of the Congress*

SECTION I

Geology and Geophysics

General

The papers to be presented in this Section cover a wide field. Many authors stress the need for closer integration of the various specialized lines of approach to achieve a better understanding of the problem of oil accumulation. The interpretation of the specialists' data must be considered in its entirety.

The lack of geological papers on South American areas other than Venezuela and also on Far Eastern areas is noted.

Two important papers concerning the resolutions passed at the Third World Petroleum Congress will be presented and discussed during the sessions of this Section. The first of these concerns the resolution which called for "generally accepted definitions and simple methods of analysis of various kinds of organic matter occurring in geological formations". A committee was set up to implement this resolution and its report, contained in a contribution by Illing (Great Britain), Louis (France), and Schultze (Germany), proposes a nomenclature and gives definitions. Further study is recommended.

The second resolution on which a report has been prepared is that which suggested the need for the study of the regional distribution of sedimentary layers and of the degree of variation of properties of sediments within one layer. This report is being presented by Vatan of the Association Internationale de Sedimentologie and emphasizes the need for continued research and close co-ordination between geophysical and petrophysical reservoir studies.

There are a total of 36 papers in the main part of this section and they are grouped under six main headings.

Regional Geology of Petroleum

The five sub-sections of this group deal respectively with America, Europe, Middle Europe, Africa, and Asia.

The first sub-section includes six papers on Canada, the United States, Mexico, and Venezuela, and it is to be regretted that no contributions have been made from countries such as Bolivia or Peru, where recent developments have doubtless afforded new data.

The paper on Western Canada by Caley, is a compact geological review of the oil-bearing areas of the Western Provinces, their development and prospects.

In regard to the United States, Hubbert and Willis present a valuable compilation on oilfields in that country which derive production from formations in which fracturing provides the essential permeability. As 1·5 per cent of the cumulative production in the U.S.A. is calculated to have been obtained from such reservoirs, with a probable ultimate minimum yield of 2·5 billion barrels, their importance is without question.

Halbouty and Hardin, discussing the discovery of large oil and gas reserves in salt dome structures in the Texas-Louisiana Gulf coast, ascribe the success in modern development of oil reserves from these areas of thick tertiary sediments affected by salt dome structures to the recognition in sub-surface studies of the major roles played by tectonics and stratigraphic traps.

Venezuela has two papers, the first, by Dufour, being a stimulating survey of oil accumulation affected by complex structural trends. Emphasis is laid on the importance of Cretaceous sediments in affording oil source rocks from which regional migration of oil has occurred. The second, by Schwark Anglade, of the Ministry of Mines and Hydrocarbons, is intended to introduce the geological map of Venezuela which, prepared in 1953, locates the mineral resources of the country as well as the main topographical features.

A paper on high relief limestone structure in the Gulf Coastal Plain of Mexico is expected.

In the sub-section on Europe two papers, one on oil search in Sicily and one on the oil possibilities in Greece, are scheduled for presentation. In view of recent developments in Sicily, the former should be distinctly opportune.

In the Middle Europe section, the Wealden formation in the Netherlands is dealt with by Sung, who postulates that beds of two differing facies and separated by a "ridge" are of similar age to the Wealden formation of S. E. England.

In discussing oil accumulation in N.W. Germany, Hoffman and Schott present a thorough stratigraphic review of the formations of the Jurassic Basin, with characteristics of the reservoir rocks and oil distribution. They draw the conclusion that oilfields occur in areas of troughs developed during the Jurassic period.

Bonnard and his colleagues are proposing to deal with the oil possibilities in the Jurassic in Middle Europe and in France in particular.

At the time of writing none of the papers included in the African or Asian sub-sections are available. It is expected, however, that one paper on French Equatorial Africa will be presented and two papers on Iran will deal respectively with the Oligo-Miocene marine formation in the Qum region and with the geology of Central Iran.

Geology of Reservoirs

A study of the cementation characteristics of selected oil reservoir sands of the Mercedes field, Venezuela, leads to the hypothesis that ionic impedence of the cementing media has occurred across clay-shale contacts during compaction.

Under this heading a paper on "Location of Petroleum Accumulation by Facies Studies" by Sloss of the Northwestern University, Evanston, Illinois, is also scheduled.

*This review has been compiled from material made available immediately before the Congress, it does not, therefore, always include references to papers for which preprints were not available at the time of preparation of this article.

Origin and Accumulation of Oil

Comparison of the chemical changes in selected crude oils as a result of weathering in the laboratory is made with crude oils from wells and seepages in certain French oilfields, in a paper by Bienner and his associates in the Institut Français du Pétrole.

Occurrence of liquid hydrocarbons in recent shallow water sediments has been established in cores from two Louisiana wells, and Smith, in dealing with the present status of knowledge on oil origin and accumulation, estimates that 10 million barrels of crude oil per cubic mile of sediments are available.

The study of patterns of distribution and thickness trends of the various types of sand bodies encountered in recent deltaic deposits of the Mississippi river affords Fisk a guide to the interpretation of the environments under which similar sand bodies containing oil have been formed.

Paleontology and Ecology

In the first paper of this sub-section, Doeglas summarizes studies on the regional sedimentology of the Rhone and Rhine rivers, the deltas of the Rhone and Orinoco, and the Gulf of Paria, and pleads for world-wide studies of environments with standardized techniques for laboratory analyses.

In considering the Cretaceous-Eocene boundary in Italy, Cita has made a micro-paleontological study of several stratigraphical sections, and the faunal changes occurring in the passage between Cretaceous and Eocene where uninterrupted sedimentation exists are ascribed solely as evolutional.

A review of American literature in the fields of paleontological and ecological advances and trends is given by Hanna.

The remaining three papers in this sub-section are understood to discuss the ratio between pelagic and benthonic foraminifera as a means of estimating depth of deposition of sedimentary rocks, the stratigraphic correlation of Upper Cretaceous and Lower Cretaceous in the Tethys and Boreal by the aid of microfossils, and micropaleontological studies.

Geophysics

The six papers in this group, of which four are by U.S. authors, deal with the application of various geophysical methods to meet the constantly changing conditions of exploration.

The field results of electrical resistivity and telluric surveys, taken from areas in Europe (France) and Africa (North, West, and Madagascar), are given in a paper by Migaux and Kunetz. The adoption of these methods on a wider scale is urged.

Growing interest in offshore exploration has led to striking developments in geophysical technique, particularly in regard to the airborne magnetometer, the remote-controlled gravimeter, and adaptations in seismic surveys and developments of radar surveying systems. These matters are dealt with in a paper by Cortes and Gsell.

Discussing new developments in seismic methods, Salvatori lays principal emphasis on improved techniques in seismic reflection methods, pattern shooting, instrumentation, shothole equipment, and transport.

The importance of close co-ordination between geological and geophysical data is stressed by Agnich, who lists criteria for the detection of reefs by seismic methods.

In dealing with modern methods of gravity and magnetic interpretation, Hammer develops the reconnaissance role of magnetic and gravity surveys in exploration, whereby the more costly phases of exploration are localized.

Finally, Figueroa reviews progress in geophysical technique of exploration in Mexico since Government control of the petroleum industry fifteen years ago.

Correlation of Geological-Geophysical Studies

Fusion of geological and geophysical data to provide sound interpretations is illustrated by examples from Canada in a paper by Skeels, who recommends gravity surveys over known structures as a basis for interpretations over virgin areas.

Post-war gravimetric and seismic programmes have aided a better understanding of the stratigraphy and tectonics of the Po Basin. This is the point made by Rocco in a paper on comparative studies in that area, while Bentz and Closs, discussing development in geophysical and geological exploration for oil in Germany 1951-54, consider that geophysical technique has led to an intensification of surveys and discovery of several oilfields. The results from this have aided further stratigraphical and tectonic studies.

Geophysical work in Germany is now also the subject of a paper on reflection-seismic exploration of Schleswig-Holstein and its geological interpretation by well data, by Hecht, Helms, and Kehrer.

SECTION II

Drilling and Production

The papers in this Section cover a wide field and range in character from the broad review to the research study. Their authors represent twenty-five separate oil companies, faculties, and other organizations, and their contributions have been sent in from nine countries.

A somewhat arbitrary classification of the papers by subject matter results in pride of place being given to primary production, on various aspects of which seven papers will be presented. Parenthetically it is to be noted that secondary production, somewhat suprisingly, has attracted only two contributions, though the paper "Recovery Increase by Thermal Drive" might more readily have been included in this group than under primary production. Engineering and allied subjects grouped under the heading "Material Problems" also account for seven of the contributions. There will be four papers on drilling fluids, while the remaining nine are classified under well completion (two papers), drilling techniques and borehole services (three each), and terminology of petroleum reserves—a contribution by Lahee.

Drilling Fluids

This section opens with a paper by Thomeer on the behaviour of shale formations when exposed in boreholes, and on the selection of drilling mud properties to overcome difficulties experienced in drilling through them. The author deals with the subject in a general manner, but emphasizes the effect of rock pressures on plastic and brittle shales. The paper does not include a discussion of specialized muds or mud treatments.

In a paper entitled "Flow Characteristics of Oil Base Drilling Mud", Fitzpatrick describes the results of an experimental study of the flow characteristics of a specialized drilling fluid in use in Trinidad. He finds that the fluids behave like Bingham bodies in stream-line flow and follow the Fanning equation in turbulent flow. The paper includes a description of what the author aptly names a "Panpipe viscometer", which he designed to overcome the difficulty occasioned in other types of viscometer by the increase in thixotropy between one determination and the next when recording viscosity under varying heads.

A symposium on drilling muds is to be presented by a group of authors from the Institut Français du Pétrole. This takes the form of a series of short papers which deal with various aspects of mud under the following sub-titles: (*a*) Study of the behaviour of drilling muds under high temperature and high pressure, (*b*) a new method of quantitative evaluation of colloidal products used in drilling muds, (*c*) apparatus for the continuous measurement of rheological characteristics of drilling muds, (*d*) the problem of drilling through cavernous formations (at Lacq in Southern France), (*e*) research into, and application of, new drilling mud additives.

Well Completion

Two contributions are to be presented in this group. The first, "Modern Well Completion Methods in U.S.A." by Solliday, takes the form of a review and covers the subject from the stage of drilling into the productive horizon to the evaluation of the results. Curlet and Pike, in a paper entitled "Oil Well Gravel Packing Operations in Trinidad", deal with the development of gravel packing as a completion and repair technique in unconsolidated Miocene sands. The operations of gravel packing and the equipment used for the purpose are described, and results at a number of wells are recorded.

Drilling Techniques

A paper entitled "New Drilling Developments" by Brooks, Randerson, and Schall, reviews a number of potential drilling methods of more or less unorthodox character. It includes, however, a brief description of various types of specialized drilling bits which have achieved wide usage, and refers also to the recent development of air circulation in oil well drilling. Average reservoir pressure is to be discussed by Horner and techniques of drilling and producing high drift angle directional wells by Johnston and Carried.

Borehole Surveys

The subject of borehole surveys has received attention from three contributors. In "A General Theory of the Eltranslog", Belluigi records the derivation of a series of theoretical determinations by which new properties of geoeltrans may be deduced and possibly applied to the science of borehole logging.

A novel method of taking fluid samples from formations forming the wall of a borehole is described in a paper to be presented by Delacour. Samples recovered by the device can be brought to surface, retaining approximately the reservoir pressure.

Primary Production

Under this heading are grouped seven contributions covering a variety of somewhat loosely-related subjects. In the first paper entitled "Recovery Increase by Thermal Drive", the authors, van Heiningen and Schwarz, discuss temperature-viscosity relationships, review possible heating methods, and examine a hypothetical case of hot water flooding. Heating by combustion *in situ* is mentioned, but not discussed. A study on P.V.T. relations of reservoir fluids is contributed by a group from the Agricultural University of Wageningen. The authors propose that P.V.T. data of reservoir fluids be determined by standard laboratory tests, and claim that a lower degree of inaccuracy can be obtained using this method than by attempting to imitate actual behaviour in a reservoir during production.

A symposium on the "Recent Application of Reservoir Treatment in Venezuela" will be contributed by a group of representatives from a number of the principal companies operating in that country. The paper deals with such treatments as fracturing, acidizing, and chemical injection as applied singly or in combination to a variety of reservoir types. Statistical data on treatments and results are given, and trends in technique are covered.

"Pipeline Flow of Oil and Gas Mixtures" by Baxendell is a contribution dealing with the problems of flow line performance which arise in Venezuela, where wide spacing and gas conservation necessitate two-phase delivery from the fields to centralized facilities.

In a paper entitled "Problems of Very Heavy Oil Production in California", McCullough describes the elaborate techniques which have had to be developed to deal with oils of less than 12° API gravity. The author discusses the problems of production and treatment, and closes his paper with a note on the economics of heavy oil operations.

A contribution on the subject of gasoline recovery from natural gas by plant designed to eliminate hydrates is presented by Aymon and Narbonne. The paper describes how this difficulty was overcome by the Régie Autonome des Pétroles during the second world war with a plant which has now been superseded by the modern automatic portable units in common use.

Secondary Production

Bukley, in a paper entitled "Correlation of Ultimate Oil Recovery with Reservoir Characteristics", reviews the factors which determine the selection of the recovery process, both primary and secondary.

"A Theoretical Investigation into the Recovery of Oil from Fissured Limestone Formations by Water Drive and Gas-cap Drive" is contributed by Birks. This paper discusses the results of laboratory studies of the dynamics of oil production from the type of composite reservoir system presented by blocks of low-permeability oil-bearing limestone dissected by a fissure system.

Material Problems

There are seven papers in this group, four of which deal with engineering subjects.

Hohmann and Buskin have analysed the performance of drilling hoists in the light of the masses and moments of inertia of the moving parts. They draw attention to the limitation of effective hoisting speeds, resulting from the time consumed by acceleration from stationary to full speed, and conclude that torque converters can compensate to a large extent for lack of applied skill on the part of the driller in operating the hoist at maximum capacity.

"Foundation Problems for Marine Drilling Platforms" is the title of a paper to be presented by Kranendonk. The paper deals with the design and construction of platforms, as distinct from submersible barges, to suit the varying conditions which may obtain at the site. Examples of structures designed for Lake Maracaibo, the South China Sea, and elsewhere are illustrated and described, with particular reference to the conditions which led to the selection of the appropriate structure.

Rogers and Rowe, Jr., in a paper entitled "Corrosion Effects of Hydrogen Sulphide and Carbon Dioxide in Oil Production", present the theory, supported by laboratory and field data, that corrosion by sulphide-bearing oilfield brines occurs in two stages; the first, which is low, obtains until a sulphide cathode of low polarization characteristics develops, and this then leads to the second or high corrosion stage.

A case for wider employment of tube or shell-type construction in the fabrication of oilfield machinery and equipment is submitted by Bierett and Bahke under the title "Investigations on and Suggestions for the Employment of Lightweight Steel Construction for Oil Drilling and Production Equipment". The principles underlying lightweight

construction are enumerated, the design of a typical derrick being considered in relation to them. Some examples of welded steel lightweight structures are described and illustrated.

The design of deep oil well casing strings to avoid collapse is complicated by the fact that hoop stress is a function of longitudinal stress. To obviate resort to trial and error methods of solution, Hefferan and Inguanzo in their paper "Design of Combined Casing Columns" have proposed a series of nomograms covering the particular case of a $6\frac{5}{8}$-inch casing string. Additional tables are presented for the analytical solution of other diameters.

"The Terminology of Petroleum Reserves" is the title of a brief but comprehensive paper submitted by Lahee. The author presents a plea for the adoption of a systemized classification of oil or gas reserves with a standardized terminology. Attention is drawn to the confusion which can arise from quantitative references to reserves without qualifying adjectives, and a simple scheme of classification is offered.

SECTION III

Oil Processing

General Problems

Under this heading, only two papers have been presented. One by Biske provides a description of the manufacture of white oils, of their uses, of the disposal of by-products and of the methods of quality assessment. The other by Galati provides information on the reconstruction of the Bari and de Liverno refineries.

Physical Operations in Oil Processing

The growing interest in the urea adduct process is indicated by three of the papers in this sub-section. One by Champagnat *et al* shows that the addition of urea to normal paraffins results in crystalline adducts and thereby provides a means of separating such hydrocarbons from petroleum fractions. The essential features of the operation of a semi-industrial plant are described together with the commercial applications of the normal paraffins. The process also results in improvements in the octane rating of motor fuels, pour points of gas oils, and the freezing point of jet fuels.

According to Goldsbrough, the purification of urea adducts by the incorporation of surface active agents and inorganic salts in aqueous urea provides an alternative to conventional filtration. The two methods are regarded as complementary rather than competitive. In the third paper experiments by Gopalan on the dewaxing of blue oils and of distillates therefrom have led to the conclusion that the saving in refrigeration costs effected by the urea process is nullified by the high operation costs.

A contribution by Orlicek, on the effect of pressure on filtering rate, provides a development of the mathematical aspect of the theory of wax filtration and also examines the influence of the consolidation of compressible filter cakes on their resistance. Orlicek shows that a maximum filter rate at an optimum pressure may be due to processes taking place not in the filter cake itself but in the boundary layer of the filter.

Another feature of filtration is dealt with by Pukkila *et al* who provide a description of the Thermofor continuous percolation process and plant for the improvement of the colour and stability of lubricating oils and waxes.

The requirements for liquid mixing have been studied by Rushton who shows how mass flow and turbulence are generated and used for producing the effects required for the different processes. Characteristics and performance data are provided for various types of equipment and hence proper specifications can be made for full-scale refinery plant.

In the field of distillation, Colburn *et al* have indicated the manner in which design and operating variables affect column operation to varying extents depending on the controlling individual mass transfer rates. Consideration of these in the gas and liquid phases provides a better understanding of the factors affecting the design and operation of plant columns. A comparison is made of allowable throughput rates and plate efficiencies for sieve and bubble cap trays.

Finally, Delpech *et al* have put on record a study of heat transfer in the radiant zones of two tube furnaces using a radiation pyrometer and a new type of wall calorimeter. The results of this study have indicated those variables which influence not only furnace control but also crude oil temperatures and pressures in different parts of the heating coil.

Desulphurization

A refining process is described by Gislon and Quiquerez whereby mercaptans are oxidized with air at room temperature in the presence of compounds such as the cobalt complex derived from salicylic aldehydes and diamines.

In connexion with the production of low sulphur content diesel oil, Hyde and Porter have described modifications to the Autofining process and have presented the results of an examination of process variables based on pilot plant operation.

To complete three very interesting papers, Padovani *et al* have discussed their theoretical and technological research on the desulphurization of light petroleum distillates.

Catalytic Reforming

This subject, which is of considerable immediate interest, has been dealt with in four papers, the first of which, by Tyson, deals with fluid hydroforming.

The contribution of Haensel and Walter concerns the effect of feedstock composition on Platforming reactions and describes typical commercial operations. The utilization of the by-product hydrogen resulting from this process is also dealt with.

Fowle *et al* have provided a review of the role of isomerization as a specific catalyst function in the field of paraffin, naphthene, and aromatic chemical production. These authors have also studied the relative importance of isomerization, dehydrogenation and dehydrocyclization for the improvement of octane rating.

The final paper by Roberts *et al* provides a description of a fixed bed catalytic reforming process, the distinctive features of which are the use of a platinum catalyst at relatively low pressure and the employment of a special regeneration technique.

Catalytic Cracking

The contributions to this subject give a clear indication that there is still much to be learnt, particularly about the activity of catalysts. Small *et al*, for example, discuss the relative effect of deactivity changes on the performance of silica-alumina cracking catalysts. They show that the extent of thermal deactivation is dependent on both time and temperature and is accompanied by changes in surface activity and by a small loss of water. Trace metals present in the feed have an appreciable effect on performance but have little effect on surface properties of partially-deactivated catalysts.

Furthermore, in the paper by Nagelstein it is postulated that alumina and alumina-containing catalysts are in fact mixtures of differently active and selective components. These authors submit proposals for improvements in the preparation of cracking catalysts and have provided descriptions of the experimental continuous manufacture of alumina of increased activity and selectivity.

Improvements in catalytic cracking processes are constantly being made and in a paper by Gohr the post-war process and design development of the fluid cracking process is summarized.

De Sanctis discusses the influence of catalytic processes on the operation of Italian refineries for home and foreign markets. He provides details of a typical mode of processing Middle East crude together with the procedure adopted for the upgrading, by catalytic cracking and reforming, of selected cuts to provide high octane fuels.

Beukers describes the operation of a combination unit at the Esso Antwerp refinery and Noll *et al* have presented a statement on the present status of the Houdriflow process together with details of mechanical features and of recent commercial experience.

Finally, Bergstrom *et al* discuss the improved mixed-phase feed technique currently being used in several commercial Thermofor units. The causes and effects of heavy metal poisoning are described together with a method of removing the metals from the system along with the catalyst fines.

Thermal Combustion of Heavy Residuums

The "Fluid Coking" process described by Voorhies employs no catalyst but depends on the heat and surface area provided by a circulating stream of finely-divided coke particles and is stated to be suitable for many types of low quality heavy residuals.

Another coking process is that described by Krekeler. This was designed for the production of olefins for the manufacture of chemicals from petroleum.

Chemical Operations in Oil Processing

In this connexion, le Nobel has dealt with certain aspects of gasoline treating processes with particular regard to sulphur problems.

Peters has described the mechanism of the hydrogen reaction of hydrocarbons and the role of hydrogen in aromatization.

Goppel and Knotnerus have made a study of the reactions involved in the air oxidation of bitumen and of the extent to which each contributes to the overall modification of the properties of the material. A method for making an oxygen balance has been devised and the distribution of oxygen over the various conventional groups in blown bitumen has been determined. Essential reactions are the formation of ester groups and carbon to carbon bonds, the latter increasing with increasing temperature of blowing, and it is of interest to note that at temperatures below 250 C, ester formation, which requires more oxygen, prevails.

Symposium on Shale Oil

With regard to the technological developments in retorting Colorado shale oil, of the various processes examined by Guthrie, the gas combustion method, using a continuous single-vessel, counter-current, gravity flow retort proved to have many advantages. In a similar connexion it is of interest to note that Schachter has reported his pilot plant experiments on the combustion of Israeli shale oil.

The shale oil industry of Sweden has been described by Gejrot and Schjanberg, and Delgado and Jurado have dealt with the production of lubricating oil by the low temperature hydrogenation of Spanish shale oil.

Atmospheric and Water Pollution

Four papers under this heading indicate that atmospheric and water pollution are by no means being ignored by the petroleum industry. Kirby, for example, describes the steps which have been taken to avoid atmospheric pollution by a refinery processing Middle East crude. These steps include the recovery of hydrogen sulphide and its conversion to sulphur, the provision of stripping columns for malodorous water streams, and the adoption of regenerative refining methods for volatile products. High smoke stacks have been adopted and mechanical seals have been fitted to pumps which handle hydrogen sulphide bearing liquids.

McCallum *et al* have outlined the means taken during the design of the Fawley refinery to minimize air pollution. These include the use of gas for furnaces and the provision of cyclones, for the removal of solid particles from effluent gases, and special types of furnaces and smoke stacks. Sulphuric acid has been excluded as a refining agent in order to minimize sulphurous fumes and a deodorizing plant has been provided for the treatment of spent caustic soda. A sulphur recovery unit is also included in the refinery design.

McCallum *et al* have described a plant for the deodorization of aqueous effluents. This consists of the combined neutralization and stripping of spent caustic soda and hydrogen sulphide bearing streams. The carbon dioxide component of hot boiler-flue gas is employed to release sulphur compounds which are then stripped by flue gas and steam. The corrosion of the unit is also discussed.

Giraud-Desjuzeur *et al* provide a description of a recording colorimeter for the determination of phenol in plant effluents. This instrument incorporates a photomultiplier whose current output is sufficient to operate the recorder. The phenol is coupled with diazoparanitrobenzene chloride and the colour turns from yellow to orange then to red with increasing phenol contents.

Hydrogenation

Bradley *et al* have indicated that with the availability of increasing amounts of hydrogen as a by-product from catalytic reforming and with the invention of processes capable of up-grading stocks, hydrogenation is becoming an important refinery process. It is learned from Pier that the demand for furnace fuel oil in Germany is comparatively low and hence crude must be entirely converted into lighter fuels; in fact equal quantities of gasoline and diesel fuels. It is, therefore, fortunate that the combination of thermal and catalytic cracking with hydrogenation is easily capable of producing high grade fuels from Middle East and German crudes.

Summaries of Sections IV to IX are given on pages 148 to 156.

The President and Vice-Presidents of the Fourth World Petroleum Congress

Professor M. Boldrini, *President of the Congress, combines both academic and commercial interests. He is Professor of Statistics and Head of the Faculty of Economics and Commerce at the "Universita Cattolica" in Milan and is also President of the oil companies AGIP, IROM, and ROMSA, Vice-President of "Ente Nazionale Idrocarburi" and President of the "Societa Termoelettrica Italiana".*

Professor Boldrini holds a doctorate in economics and is a member of the Pontifical Academy of Sciences and a national member of the Academy of "Lincei".

Professor Boldrini is also the chairman of the General Organizing Committee of the Congress.

Lt-Col S. J. M. Auld, *O.B.E., M.C., D.Sc., President of the Institute of Petroleum, is the chief British representative at the Congress. After eighteen years with Socony Vacuum Oil Co. Inc. and the Vacuum Oil Co. Ltd., Colonel Auld retired from his position as chief technologist to Vacuum in* 1946. *He is now a director of American Locomotive Export Co. Inc. and other companies.*

In addition to his vice-presidency of the Fourth World Petroleum Congress, Colonel Auld holds the positions of Honorary Treasurer of the Permanent Council of the World Petroleum Congress and chairman of the British National Committee.

Professor J. Colomo, *who represents Mexico, is assistant managing director (production branch), and a member of the Board of Directors, of Petroleos Mexicanos. In addition, he is Professor of Petroleum Engineering at the Universidad Autonoma de Mexico.*

Before joining Petroleos Mexicanos, Professor Colomo held important positions in the Mexican Government Petroleum Department and later became assistant general manager of the official Mexican Government Petroleum Institution.

Professor F. P. Malschaert, *who represents Belgium, is Professor of Automobile and Aeronautical Engineering and director of the Automobile Laboratory at Ghent University. He is President of the Société Belge pour l'Etude du Pétrole and its standardization committees.*

Professor Malschaert is the author of many articles on the testing of petroleum products, viscosity, and automobile engineering. He is also a member of many engineering societies.

Dr E. V. Murphree, *from the U.S.A., is President of the Esso Research and Engineering Company (formerly the Standard Oil Development Company) and also a director of Jasco Incorporated, Standard Catalytic Company, and the International Catalytic Oil Processes Corporation.*

Dr Murphree is a member of many scientific bodies, including the American Petroleum Institute, the Institute of Petroleum, the American Institute of Chemical Engineers, and the Society of Chemical Industry.

Dr Murphree is also chairman of the Permanent Council of the Congress.

Professor R. Navarre, *the French representative, is Director-General of the Institut Français du Pétrole and also Professor of Refining at the Ecole Nationale Supérieure du Pétrole.*

Professor Navarre was concerned for a number of years with the installation and running of the refinery at Port Jerome which was set up before the second world war by a French affiliate of the Standard Oil Development Company.

Professor Navarre was recently appointed Secretary of a French Parliamentary Committee for Sciences and Technologies. He is a member of the Permanent Council of the World Petroleum Congress.

A. A. G. Schieferdecker, *from the Netherlands, served with the Royal Dutch/Shell group of Companies from* 1918 *to* 1952 *when he retired. During this period de Heer Schieferdecker worked in many countries before being transferred in* 1931 *to the production department of the Group's main office at the Hague. In that department he acted as adviser on production in Mexico, Venezuela, Argentina, Roumania, the Netherlands, Germany, and Austria.*

De Heer Schieferdecker was vice-chairman of the Organizing Committee for the Third World Petroleum Congress held at the Hague in 1951.

G. Schlicht, *representing Germany, is a member of the Managing Board of Deutsche Erdöl-Aktiengesellschaft, Hamburg. He is also deputy-chairman of the Managing Board of the Mineralöl-Wirtschaftsverband (Association of the Mineral Oil Industry), a member of the presiding body of the Arbeitsgemeinschaft Erdölgewinnung und Verarbeitung (Association for Exploitation and Refining Crude Oil), and a Past-president of the German Society for Petroleum Sciences and the Chemistry of Coal.*

Dr R. K. Stratford *from Canada, is scientific adviser to Imperial Oil Ltd., Ontario. He has been employed with the Company since* 1924 *and has held the positions of chief research chemist and research director in charge of the Technical and Research Department.*

Dr Stratford studied in France for his doctorate in science and has since been awarded the honorary degree of Doctor of Science by the Faculty of the University of Western Ontario and the honorary degree of Doctor of Laws by Queen's University.

Dr Stratford is President of the Research Council of Ontario and a prominent member of the Society of Chemical Industry (Canadian Section) and the Chemical Institute of Canada.

Dr G. Thery-Fombona, *from Venezuela, is director of the Technical office of Hydrocarbons in the Venezuelan Ministry of Hydrocarbons and also Professor of Industrial Law at the Central University of Venezuela.*

From 1943 *to* 1950 *Dr Thery-Fombona was chief of the Technical Department of Production and Taxation in the Technical office of Hydrocarbons of the Venezuelan Ministry of Fuel and Power.*

Dr Thery-Fombona was president of the Venezuelan delegation to the Third World Petroleum Congress at the Hague in 1951.

Lt-Col S. J. M. Auld

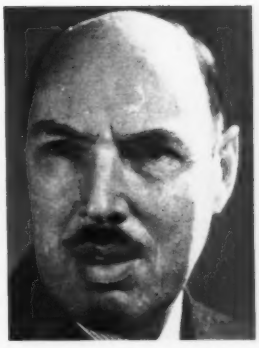
Prof M. Boldrini

Prof J. Colomo

Prof F. P. Malschaert

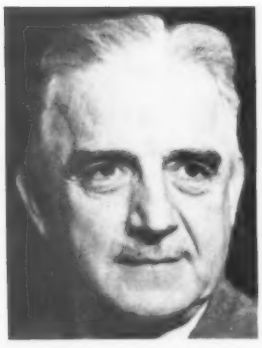
Dr E. V. Murphree

Prof R. Navarre



A. A. G. Schieferdecker

G. Schlicht



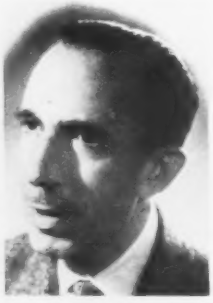
Dr R. K. Stratford

Dr G. Thery-Fombona

Chairmen of Committees

Various sections of the work of the General Organizing Committee of the Congress have been carried out by special committees dealing with technical matters; editorial matters; hotel accommodation, reception, and tours; press and publicity; and finance. Notes on the chairmen of these committees and on the General Secretary of the Organizing Committee are given here.

Prof C. Padovani



M. Mortara

Dr V. Cazzaniga

Prof F. Pennavaria

Dr G. E. Kovacs

Professor C. Padovani, chairman of the Technical Committee, is Head of the Fuel Experimental Centre at Milan. "La Rivista dei Combustibili"—a well-known Italian fuel journal—was founded by Professor Padovani who is also its Editor-in-Chief.

Professor Padovani is a member of the Permanent Council of the World Petroleum Congress and a member of the General Organizing Committee for the Fourth World Petroleum Congress.

M. Mortara, who is chairman of the Editorial Committee for the Proceedings of the Congress, is managing director of CONDOR.

He is a member of the General Organizing Committee for the Fourth World Petroleum Congress.

Dr V. Cazzaniga, who is chairman of the Hotel Accommodation, Reception, and Tourist Committee, is President of Esso Standard Italiana.

He is a vice-chairman of the General Organizing Committee for the Fourth World Petroleum Congress.

Professor F. Pennavaria, chairman of the Press and Publicity Committee, is President of STOI and Professor of Constitutional Law at the University of Rome. He was formerly a deputy in the Italian Parliament and held office as Under-Secretary of State for Communications.

Professor Pennavaria is a vice-chairman of the General Organizing Committee for the Fourth World Petroleum Congress.

Dr A. A. Muston

Dr G. E. Kovacs, chairman of the Financial Committee, is general manager of IROM and holds a doctorate in political science.

Dr Kovacs is a member of the General Organizing Committee for the Fourth World Petroleum Congress.

Dr A. A. Muston, the energetic General Secretary of the General Organizing Committee for the Congress, has been responsible in large measure for the successful arrangement of the Congress.

He was assistant manager at the Head Office of Esso Standard Italiana in Genoa until October 1953, since when he has devoted himself completely to the affairs of the Congress. Dr Muston had been employed in the marketing activities of Esso Standard Italiana since 1925.

The British National Committee for the Fourth World Petroleum Congress

C. Chilvers.
Honorary Secretary of IP, manager of the Co-ordination and Economics Dept. Esso Petroleum Co. Ltd.

T. Dewhurst.
A Past-President of the IP, and formerly chief geologist, Burmah Oil Co. Ltd.

S. J. M. Auld, O.B.E., M.C.
Chairman of the Committee and President of the IP.

Dr E. B. Evans.
A Vice-President and Hon. Editor of the IP and chief chemist Esso Development Co. Ltd.

Prof F. H. Garner, O.B.E.
A Past-President of the IP and Professor of Chemical Engineering at Birmingham University.

H. S. Gibson, C.B.E.
A Past-President of IP and Managing Director of Iraq Petroleum Co. Ltd. and Associated Companies.

H. Hyams.
A Vice-President of IP. Adviser on measurement and quantity control to The Shell Petroleum Co. Ltd.

George Sell.
Editor of the IP publications.

W. H. Thomas.
A Member of Council of IP and chief analyst, The British Petroleum Co. Ltd.

D. A. Hough, T.D.
Secretary. General Secretary of IP and also of the Permanent Council of the World Petroleum Congress.

SECTION IV
Production of Chemicals from Petroleum: Properties and Application

Production and Utilization of Olefins

With the increasing demand from the petroleum chemical industry for higher olefins derived from the lower olefins (such as propylene tetramer for detergent alkylate manufacture, cumene for phenol, etc.) there is increasing interest in small-scale catalytic polymerization units which can be used either for such products or for polymer gasoline. A description of a plant of this type with operating details, yields and economics, is given by Egloff and Jones.

Guidance on selection of routes to ethylene manufacture is provided in a paper by Woolcock, who points out the problem caused by the increasing demands for chemical manufacture and the reduced yields from modern cracking processes. Apart from special cases, the choice lies between separation from refinery gases, which is applicable only to very large refineries, and special cracking of ethane and propane, rapidly becoming more important. There is also considerable technical interest in the cracking of heavy fuel oils to ethylene.

This possibility is amplified in the paper by Patry, Luzzareta, and Paul, which describes experiments for the production of ethylene and propylene by catalytic gasification of heavy fuels. One process, on a semi-continuous basis, consists of flash distillation of heavy fuel oil, using the residue to heat tubes containing a catalyst into which the distillate is injected with steam. A second, cyclic process consists of a conversion stage in which fuel oil is injected with steam over a nickel-base catalyst in a refractory-lined cracking chamber, the heat being provided by a second stage in which carbon is burned off the catalyst.

A paper by Limido gives guidance on the more important lines of approach in the organization of research on the reactions of olefins.

Oxidation of Hydrocarbons

In a review of the journal and patent literature, Toland and Nimer briefly describe processes for the separation of xylene isomers, their oxidation to dibasic acids, and subsequent esterification. Processes which are described in greater detail are the production of: (*a*) phthalic anhydride from *o*-xylene, (*b*) dimethyl phthalate from *m*- or *p*-xylene, and (*c*) terephthalic acid from *p*-xylene.

A description of processes for the direct oxidation of methane, ethane, propane, and butane is given by Powers with an indication of the reaction variables and their significance in commercial process development. The techniques described include vapour phase catalytic or non-catalytic oxidation and liquid phase oxidation. Future trends in the greater use of methane and ethane and the more complete and selective oxidation of propane and butane are discussed.

A process for the partial oxidation of methane to acetylene, as described by Bartholome, involves incomplete combustion of natural gas with oxygen into CO, CO_2, and H_2O, which raises the temperature to about 1400°C and provides heat for transformation of the remaining methane into acetylene and hydrogen. Plants operating by this process have been set up in the U.S.A. and in Italy.

Balaceanu discusses the wide variety of oxidation processes, and the variety of products formed, showing that any broad codification is unlikely. In order to provide data for plant operation, it is necessary to make a fundamental study of the particular oxidation reaction, including activation, location of the reaction, its mechanism and kinetics, etc.

Padovani and associates have studied the kinetics of the partial oxidation of methane by oxygen and air over a nickel catalyst and have experimentally confirmed the hypothesis of a two-stage mechanism. The first stage is the complete oxidation of methane, and the second the reaction of these oxidized products with the residual methane to CO and H_2. The rate of the first reaction is, however, greater than that of the second, which is attributed to the different energy content. The study made enables guidance to be given in the selection of optimum conditions for industrial use of the process.

Further papers are to be presented on the production of chemicals by direct oxidation of hydrocarbons, in particular cumene, and on the oxidation of gas oil, the latter by Schächter.

Various Developments

Sanford reviews the derivation from petroleum of a wide range of anionic, cationic, and non-ionic surface active agents and discusses applications of particular interest to Australia. These include their use in poultry food, veterinary and agricultural preparations, washing of foodstuffs before canning, conditioning of wheat, etc.

Acrolein is potentially available from the catalytic oxidation of propylene and according to Ballard and associates shows extremely versatile chemical reactivity, which is associated with the double bond, the CO group, and its conjugate structure. Its primary derivatives themselves are highly reactive, this leading to a wide field of further derivatives.

Hutchinson and Stevens have described the development of the Canadian petroleum chemical industry which started in 1942 with the production of synthetic rubber at a critical wartime stage. The article describes the location of plants in relation to markets and oil and natural gas resources, and lists capital cost of plants, processes utilized, and products obtained. It is pointed out that the limited requirements of the Canadian market are frequently below economic plant size.

The great strides which have been made in polyethylene production since 1939 are emphasized by Burk and Strain who discuss its suitability for major applications, viz., film, wire and cable, pipe, moulded articles, paper coating, bottles, etc. They also discuss the significance of its structure in relation to properties, and its resistance to oxidation and thermal decomposition.

An interesting example of the use of natural gas for chemical manufacture is the four-stage acrylo-nitrile plant described by Thurston and associates. Acetylene is first prepared by partial oxidation of methane and HCN by ignition of natural gas, air, and ammonia on a hot platinum alloy gauze. These products are then catalytically combined to produce acrylo-nitrile.

Fundamental research on free radical reactions is reported by Kooyman. This throws some light on oxidation reactions of hydrocarbons, both for the production of chemical products and in the deterioration of oil products. He discusses structural factors in relation to the reactivity of hydrocarbons towards free radicals, *e.g.* strength of chemical bond, presence of polar groups and of ring systems and steric factors, illustrating these with examples of appropriate reactions.

Hixon describes the manufacture, properties, and applications of chemical derivatives from (*a*) the refining of

petroleum distillates, *e.g.* naphthenic acids and petroleum sulphonates; (*b*) petroleum wax, *e.g.* synthetic detergents by direct carboxylation, or by sulphation of primary alcohols derived from olefins by the OXO process, or by sulphation of olefins from wax cracking, and (*c*) solvent extraction of lubricating oils.

The present stage of the United States petroleum chemical industry is outlined by Cunningham in terms of the supply of hydrocarbons, inorganic chemicals, and synthetic organic chemicals. He discusses the common features of three large oil-chemical companies and emphasizes the dependence of their success on research, process development, market research, market development, and technical service, and on a patient investment policy.

A paper by Kölbel will describe new developments in hydrocarbon synthesis.

Hopff and associates describe the possible applications of the Friedel-Craft reaction to aliphatic and hydro aromatic hydrocarbons, with particular reference to the condensation of *cyclo*hexane with phthalic anhydride in the presence of $AlCl_3$ and oxygen-containing components. A further possible condensation is that of *cyclo*hexane or normal pentane with sulphur, using an $AlCl_3$ and HCl catalyst.

According to a report by Ballabio, the Italian petrochemical industry has made a good start in its production of petroleum chemicals by the construction and operation of a plant at Ferrara. This produces a wide range of derivatives of propylene and ethylene obtained by thermal cracking, styrene polymers and copolymers, and polyethylene, including the production of I.P.A. by direct hydration of propylene. An ammonia plant there is based on hydrogen obtained by the cracking of natural gas.

A study of processes developed by the Institut Français du Pétrole for the dehydration of secondary alcohols to ketones is presented by Coussemant. This is achieved in the liquid phase at 150° C, hydrogen being continuously removed. It is claimed that yields are very high and that only simple, low-cost equipment and utilities are required.

The last paper in this section is one by Natta, describing recent developments in the chemistry of olefins in Italy.

SECTION V

Composition of Petroleum: Analysis and Testing, Measurement and Control

The emphasis in this section is on the application of the newer techniques to the study of the composition and constitution of petroleum and its products. Nine papers are concerned in their separate fields with the extension of knowledge resulting from, and the analytical advantages gained by, the use of chromatographic separation and vapour-phase chromatographic analysis; hydrocarbon analysis by the n-d-M method; ozonolysis; mass spectrometry for heavy oil composition; radio-activity; the determination of ultra-sonic velocity for structural investigations—all but the last of these techniques being capable of application further towards the less volatile petroleum fractions.

In his paper, Baldeschwieler reviews a wide field in the developments in analytical chemistry and discusses new techniques that have become available in the past few years. This author has made a survey of methods for the period 1950-53, classified them, and indicated techniques of major interest. Under instrumental techniques he finds that the majority are based on the use of the electro-magnetic wave spectrum, and he includes three tabulations showing the application of gamma rays, electron rays, and X-rays through to the longer rays, ending in visible and infra-red waves.

Keulemans and Kwantes outline the techniques of vapour-phase chromatography and describe certain developments that have occurred since the publication of material by Ray in the Journal of Applied Chemistry in 1952, when this author applied the technique to the separation of mixtures of hydrocarbons and oxygenated compounds. The flexibility of the method is illustrated by means of practical examples: C_2 hydrocarbon gases containing methane, a full-range gas from cracking, hydrocarbon fractions in the gasoline range, a xylene fraction from platforming, and also other types of organic compounds such as mixtures of ketones, and a mixture of all possible homologues and isomers of the fatty acids from C_1 to C_5.

X-ray Analysis

The application of mass spectrometry to the analysis of the heavier oils is described in a joint contribution from five authors. In combination with physical separation techniques it is possible to determine both molecular-weight distribution and hydrocarbon-type compositions. Two examples given are the determination of wax composition and analysis of lubricating oil as applied to the dewaxing of lubricating oil raffinates. The authors anticipate that new mass spectrometric approaches will provide a means of analysing even the residual oil fractions from petroleum.

Reference has already been made to radio-active methods of chemical analysis. This particular application, employing the phenomenon of radio-activity, is discussed in a paper by three authors, who state that present applications consist of analytical laboratory and refinery control-laboratory chemical determinations on batch samples withdrawn from process streams. It is now possible for the X-ray absorption method in the determination of sulphur in hydrocarbons to be modified by replacing the X-ray tube with a radio-active source of X-rays, three-year iron-55. The other radio-active applications which are discussed in this paper extend over a wide range of petroleum technology: in exploration for new oilfields, in pipeline transportation, and in refining processes, also the use of radiotracers for laboratory research techniques both in petroleum chemistry and in applicational research as in engine wear and engine deposit studies.

The determination of the ultra-sonic velocity has been introduced as a method for structural investigation of liquid substances, and this technique is developed further by Baccaredda in the determination of the degree of branching in petroleum fractions. In this paper general information is first given on methods of structural group analysis with special reference to the determination of mean branching degree, by means of measurement of surface tension and calculation of the specific parachor. The advantage over this procedure of the ultra-sonic velocity method is that it is much less affected by impurities present in the substance being investigated.

The analytical possibilities of using the ozonolytical degradation process in order to obtain information about the

structure of the aromatics in petroleum is described by Boer. He states that the method compares favourably with spectroscopic methods since it is applicable to higher boiling fractions. Ozone is one of the very few reagents that attaches itself to an aromatic nucleus without at the same time destroying its substituents. A technique is described for the conversion of the products of the reactions between ozone and polyalkylbenzenes into volatile fatty acids; in this way, each aromatic carbon atom is recovered in the form of a carboxyl group. The acids are identified by vapour-phase chromatography.

Bestougeff and Bargmann make a different approach to the chemical analysis of heavy petroleum products. They have developed a scheme, which also uses new fractionating techniques, for the complete analysis of heavy petroleum residues and bitumens. In particular, the method of gradual precipitation, and the chromatographic and the fractional crystallization techniques have been improved. Separation of sulphur compounds has also been studied.

Two papers are concerned with advances in apparatus design. Powell and Evans describe a variable-thickness cell for infra-red absorption spectrometry. Only by means of a variable cell can the merits of double beam spectrometry be fully exploited. The use of the cell is illustrated in the determination of additives in lubricating oil blends; although there is no workable difference between the spectra of the blend and base oil, the differential spectrum is specific. Thus it is possible to determine the additive concentration quantitatively. In the other paper, Davies, Phillpotts, and Swanson describe an apparatus for the rapid and precise ebulliometric determination of molecular weights. This uses Thermistors as electrical resistance thermometers and achieves a thermometric lag ten times less, and an accuracy some five times greater, than those of Beckmann thermometers.

Hydrocarbon Research

At this point it is appropriate to draw attention to Miller's "Review of American Petroleum Institute Research Projects on Composition and Properties of Petroleum". A review of seven active API research projects is included. These are: the analysis, purification, and properties of petroleum hydrocarbons; the synthesis, purification, and properties of hydrocarbons of high molecular weight; data on hydrocarbons and related compounds; the synthesis, purification, and properties of hydrocarbons of low molecular weight; the synthesis, properties, and identification of sulphur compounds in petroleum; investigation of thermodynamic properties of hydrocarbons and related compounds; and nitrogen constituents in petroleum.

The next group of six papers deals broadly with the composition, properties, and behaviour of representative crude oils and their products.

In the paper "Analytical Research on Italian Crudes", to which six authors have contributed, crudes from the Cortemaggiore field and gasolines from Caviaga, Ripalta, and Bordolano fields have been analysed by procedures generally used: distillation, chromatography, dehydrogenation, and physical methods. The lighter samples were examined with the infra-red spectrophotometer, and medium fractions by the urea-adduct method.

In a report on some of the work which was sponsored by the Institute of Petroleum Research Committee No. 2 in connexion with the investigation of the relationship between the constitution and biological activity of petroleum fractions, Kuwait heavy gas oil has been studied. In the present report Carruthers *et al* describe the precise fractionation of a middle distillate fraction from a Kuwait crude oil, and present structural group analyses of the eight 5°C-fractions boiling between 350° and 390°C, by the n-d-M method.

Sulphur Compounds

Two papers are concerned with the occurrence of sulphur in petroleum. It is pointed out by Nelson *et al* in the paper entitled "Relationship between Sulphur Content of Crude Oils and the Sulphur Content of Conventional Refinery Products", that no comprehensive study is available whereby the behaviour of various oils can be compared with one another. This is the case in spite of the fact that excellent surveys pertaining to the amount of sulphur in crude oils, gasoline, and cracked products have been published. These authors have prepared charts which may be used to estimate the sulphur content of straight-run and cracked products derived from certain representative crudes if only the sulphur content of the crude is known. The second paper, "Heterocyclic Sulphur Compounds", by Roberti *et al*, is concerned with the synthesis, and examination of certain properties, of four cyclic sulphides. The authors believe that in this range of higher molecular weight compounds any work on the study of sulphur compounds in petroleum is handicapped by the lack of data on pure compounds. The boiling points, densities, and refractive indices of the four compounds synthesized are given.

Oxidation

Two papers deal with the behaviour of mineral oils towards oxidation. The first, by Pass, Pöll, and Zartl, describes the effect of ozone on various mineral oils, and illustrates the effects obtained on oils with typical oxygen absorption curves. It is claimed that by the ozonization of inhibited oils it is possible to determine the oxidation properties of the original oil, before addition of inhibitors. It is stated that the inhibitor is consumed first, which makes possible the evaluation of the oxidation characteristics of the original oil. Retardants formed by ozone treatment seem to be effective as additives to oils which have not been ozonized. The second paper, "A Critical Study of the Oxidation Stability of Insulating and Lubricating Oils", Rumpf and Jahn, discusses five national oxidation stability tests for insulating oils, Michie (BSI); Staeger (SEV); Baader (DIN/VDE); Kissling Tar No. (DIN/VDE); Skala (ÖVE). It is demonstrated that an oil which meets the specification of one country may fail the specification of another country. Based on a wide experimentation with different base oils for the production of insulating and turbine oils, a theory has been developed giving a general explanation for the oxidation behaviour of these special raffinates.

Trace Constituents

A number of papers are concerned with the determination of impurities and trace constituents in petroleum products. Levin explores the various phases of the petroleum industry and petroleum research where trace constituents are important, and discusses specifically applicable and interesting methods for making the necessary analytical determinations. Two papers discuss water content. In Davies' paper a method is given for the determination of the solubility of water in hydrocarbons. This method, in principle, measures the absorption of water from a saturated atmosphere, and is of practical importance in giving information on the rate of absorption from the atmosphere. Guyot describes a continuous recording meter based on dielectric constant measurement, which has been used for several months in various types of water gauging operations in Trinidad oilfields. The same meter was also used for the continuous recording of the toluene content in a refinery process stream. An interesting development in the quartz-tube method for determining sulphur content will be found in Weisang's paper. The novel feature is that the sample is delivered to the furnace at a rate that is consistent with the best conditions of combustion for accuracy. Combustion is carried out automatically,

and this is achieved by heating the sample at a predetermined rate.

Two papers refer to analysis and testing from the point of view of measurement and control. National standardization in Belgium is discussed by Malschaert, whilst the world-wide field of international standardization is covered for some 70 countries by Hyams. In the latter paper information is also given regarding national standards bodies, where these exist, and the extent to which they, or other local associated bodies, participate in the production and presentation of standard methods for testing and measuring crude oil and petroleum products.

The last paper in this Section should provoke an interesting discussion. It is the "Viscosity-Temperature Index Scales (VTI)" by Larson and Schwaderer. After listing 32 former proposed methods the authors consider the situation as it was left when Blott and Verver published their paper on the viscosity modulus in the Journal of the Institute of Petroleum in 1952. The VTI sca'es, now proposed, retain the popular and widely-recognized numbers of the V.I. from 0 to 100, and also retain the L-Series values. The 100 value or upper limit of the scale is represented by P, the "perfect" or ideal oil, the viscosity of which is independent of temperature. Anomalous values are avoided; the sensitivity of the scale remains the same; non-hydrocarbon materials as well as synthetics and hydrocarbon oils are equally covered.

SECTION VI

Utilization of Petroleum Products

The papers for presentation in this section fall into seven groups dealing either with particular products or particular applications.

Asphalts and Bitumen

This group consists of three papers. A paper on mechanical testing of bitumen by Saal analyses current routine tests in terms of two basic properties, *i.e.* rheological behaviour and tendency to fracture. It is concluded that penetration, softening point, flow test, and Fraass test are valuable in their relationship to these fundamental properties, but the ductility test is of limited value and shatter tests need further study. The effect of the addition of rubber to bitumen is discussed by Nijveld *et al* who describe the basic properties of such mixtures and present data on their application as joint sealing compounds and as pipe asphalts.

The third paper by Bénard and Lefol deals with methods for improving the adhesion of bitumen to aggregates in road-making and hydraulic work. Surface active additives are known to have a beneficial effect in this connexion and a method of introducing such additives by direct application to the binder-aggregate interface is proposed.

Waxes and Paraffins

A single paper is to be presented by Tiedje entitled "A Laboratory Study of Wax Processing Methods". Sweating, solvent de-oiling plus distillation, and recrystallization from a suitable solvent are compared for their effectiveness in the fractionation of a low-boiling paraffinic-type crude wax and it is shown that solvent recrystallization is the most efficient for melting point separation. This method is also the only one effective in separating high-boiling microcrystalline waxes and therefore the only one applicable to all types of petroleum wax.

Lubricants

There are nine papers in this group, covering a wide range of interests. Barwell *et al* discuss the application of some physical methods to lubrication research. The electron microscope has been successfully used for the examination of worn surfaces, for the detection of carbon particles in used detergent oils, and for elucidating the structure of greases. An air gauging method has been applied for measuring the thickness of oil films, and contact resistance determinations reveal the instant of oil film breakdown. Radio-active tracer techniques have also proved extremely valuable. The ever-interesting problem of oil oxidation is considered by Bonauguri *et al*. A modification of the Sunbury beaker corrosion test has been suggested and the experimental data acquired forms the basis of correlations which enable oils of one group to be evaluated by certain physical quantities without resorting to the oxidation test. The subject of additives is dealt with by Artozoul *et al* who attempt to relate certain physical properties of alkyl aryl sulphonates to molecular structure. The syntheses of some dialkyl dithio phosphates are discussed.

As would be expected, engine lubricants receive considerable attention and four papers are included on this subject. A general survey by Denison and Kavanagh on recent trends in automotive lubricating oil research gives examples showing the types of research advances made in internal combustion engine lubricants and in the engines themselves during the past fifteen years. The resulting improvements in lubricants have been made as a consequence of the tremendous investment by the petroleum laboratories in learning the fundamental chemistry and engineering principles involved in lubricant performance. Assessing the performance of engine lubricants involves the availability of suitable test engines and methods, and the story of the development of the C.L.R. oil test engine is told by Ainsley, Cleveland, and McLeod. This engine should satisfy the demand for a laboratory tool for lubricating oil evaluation. The customary laboratory methods for determining oil viscosity are based on the premise that motor oils are Newtonian liquids. Georgi shows, however, that this assumption is not valid for many types of motor oil, which although showing Newtonian behaviour at moderate and high temperatures, exhibit anomalous viscosity characteristics below about 0 C. Those oils containing appreciable amounts of viscosity index improvers are shown to be non-Newtonian fluids throughout the temperature range normally encountered in engines. The fourth paper on engine lubricants is by Kadmer and Mauser who consider the problem of the blow-by of combustion gases and the accurate evaluation of used crankcase oils.

Recent work on gear oils is surveyed by Towle who suggests

that such oils can be evaluated only by full-scale tests, laboratory small-scale machines giving little indication of the behaviour under service conditions. Multi-purpose gear lubricants are likely to be of the sulphur-chlorine phosphorus type for some time to come, with lead soap–active sulphur formulations for factory fill where gears are not surface treated.

Industrial lubricants are considered in a single paper by McMillan *et al* which covers industrial gear lubricants, turbine and hydraulic oils, refrigerator oils, rust preventives, and greases. It is shown that the lubricant of today must be multi-functioning, capable of performing many duties other than prevention of friction and wear between moving parts.

Heavy Fuels

This group comprises four papers all concerned to some extent with the burning of such fuels in gas turbines. Sulzer considers some methods of preventing fuel ash deposition and corrosion in gas turbines and shows that certain metallic additives are particularly successful. Aluminium silicates gave the best results of fifteen additives quoted. The effect of fuel ash constituents is also considered by Evans *et al* who describe experimental work using both laboratory combustion rigs and a 750-kW industrial gas turbine. Numerous additives were tested and magnesium compounds appeared particularly advantageous in eliminating corrosion and rendering deposits more easily removable by water washing. Another contribution to experiences in running gas turbines on heavy fuel has been made by Pfenninger. Deposit formation from the continuous combustion of oil fuels is also the subject of a paper by Lewis who discusses the burning of oil fuels under boilers as well as in gas turbines. The effect of different operating conditions upon the quantity and nature of deposits is described and the reaction of the deposited compounds with the collecting surface, and the possible mechanism of such attack, are considered.

Fuels and Combustion in Diesel Engines

Advances in both design and application of the diesel engine over recent years have resulted in numerous investigations into their fuel requirements. Blanc reviews the use of cracked distillate as a diesel fuel component and concludes that provided the requirements for cetane number and other physical characteristics are met, there should be little difficulty in getting satisfactory engine performance. Stability in storage and freedom from engine filter clogging can be obtained by refinery treatment or by use of additives. Wilson *et al* suggest three possible methods for meeting future demands for diesel fuel: (*a*) incorporation of low-octane fractions of gasoline in the diesel fuel range; (*b*) increasing the availability of cracked distillates; (*c*) utilization of residuals. Already a considerable move towards the use of residuals has been made in the field of marine and other large diesels and this may extend to engines in the medium range. For the small high-speed diesel, wide range fuels incorporating gasoline fractions are a possibility and recent research shows that such fuels can effect a significant increase in smoke-limited power whilst having no technical disadvantages. To satisfy future demands for diesel fuel, co-operation between the engine manufacturer and the petroleum refiner is necessary and this point is also made by Zwicky in a paper on fuels and lubricants for medium and large diesel engines. A drawback to the use of heavy fuel in medium and slow speed diesels is the increased cylinder wear that is experienced. Bailey and Withers consider that this may become the limiting factor in determining the lower limit of engine size that can successfully burn such fuel since it is cylinder wear which is mainly responsible for reducing the gross saving in fuel costs.

Fuels and Combustion in Spark-ignited Engines

In this group there are seven papers of widely varying content. Downs *et al*, presenting "A Unified Concept of Combustion in I.C. Engines", suggest that each particular type of I.C. engine has its own problems of combustion which are all related to the same fundamental oxidation mechanisms of the fuel. These engine phenomena are special cases of "high"- and "low"-temperature oxidation on the Townend ignition temperature-pressure curve. Improving the efficiency of automobile engines is one of the most important objectives of automotive engineers. According to Caris *et al* higher compression ratios can be achieved by using higher octane fuel and also by paying due regard to design factors of the engine. Of these engine factors, combustion chamber design offers the most fruitful field for future development. Performance is influenced by the fuels and lubricants used, and investigations reported by Sweeny *et al* indicate that by using a high octane number fuel of balanced volatility with a multi-viscosity grade lubricant it is possible, in existing cars, to save 5 to 10 per cent of gasoline used. The lubricant is formulated to reduce friction and combustion chamber deposits. Mora and Ynfiesta have studied the maximum pressure in an engine at detonating load and show that the knock waves of two fuels of different chemical composition but same octane number exhibit different characteristics. The mechanical effect of detonation is higher for a paraffin than for an aromatic fuel with the same octane number.

In a study of the road octane number of eighteen gasoline blends in fifteen cars Vichnievsky *et al* found fairly good correlation between road octane number and laboratory ratings. In the course of their work they evaluated the anti-knock requirements of two hundred vehicles.

Combustion chamber deposits form the subject of two papers. Mikita and Sturgis suggest that such deposits are formed by unburned fuel and lubricant collecting in combustion chambers to form a carbonaceous layer which then traps lead oxide resulting from the combustion of tetraethyl lead. These deposits cause an increase in octane number requirement because of their volume effect, thermal insulation properties, heat capacity, and their ability to cause surface ignition of the incoming charge. Proper selection of fuel and lubricant can minimize these harmful effects. Lovell *et al* voice similar opinions and indicate that undesirable surface ignition effects can be reduced by modifying the nature of deposits by the use of phosphorus-type fuel additives. These additives have the additional merit of inhibiting spark plug fouling. A solution of the difficulties due to combustion chamber deposits will pave the way to an increase in compression ratios and hence an increase in engine efficiency.

Uses of Petroleum Products in the Gas Industry

Rüter discusses the use of refinery gases for public gas supply and instances the case of South Holland where 30,000 tons of refinery gases per annum are supplied by a large oil refinery, mainly from catalytic and thermal cracking plants. Since the composition of these gases varies considerably the gas industry has to maintain the required characteristics by mixing with other gases such as coal gas or by converting to a more desirable product by various cracking processes. Utilization of petroleum products for town gas supplies in France is described by Delsol. The use of heavy fuel oil in the gas industry is surveyed by Malquori who discusses the economic and technical aspects of gasification for the production of gas interchangeable with both natural and the usual town gas. Methods of gasification for the manufacture of high-, medium-, and low-b.t.u. gas are described together with their application to carburetting water gas and complete gasification gas.

SECTION VII

Construction of Equipment—Materials Used and Prevention of Corrosion

The papers in this Section deal with the construction of equipment, in this case mainly refinery equipment, the materials used and the prevention of corrosion.

Petroleum Refinery Engineering

The first paper, entitled "Some Notes on Seals for Rotating Shafts" by Boon, Honingh, and van Rijssen emphasizes that the fundamentals of shaft seals are very little known in spite of the universal use of this equipment. A general discussion of these fundamentals leads up to the consideration of a low-pressure liquid seal for propane vapour and then to methods of improving the performance of a normal packing box and a "mechanical seal". These types of seals cannot meet the condition where leakage must be kept very low without a positive feed of sealing fluid towards the pump, and the rest of the paper describes the "Visco" seal now being developed, which depends on the pumping action of a sealing fluid in a groove round the shaft but also provides a tight seal when the shaft is at rest.

"Refinery Engineering in Italy" by Brizzi, Daino, di Monda, Romano, and Salmoni gives an account of the engineering organization built up in the Naples refinery of Socony-Vacuum Italiana S.p.A., for the purpose of rebuilding the refinery at maximum speed. This organization was designed to overcome the serious shortages both of trained personnel and of engineering equipment in Italy at the end of the war and the paper touches on the staff training methods adopted and describes the functions, responsibilities, and co-ordination of the sections into which the engineering department was divided. In a final table it shows the results achieved to date and indicates the future problems that will have to be met in Italian refineries.

Construction Materials

Three papers in this section deal with high-alloy stainless and heat-resisting steel, one deals with tantalum and zirconium, one with aluminium, one with hydrogen embrittlement of steel, and two with steel for storage tanks.

"Alloy and Special Steels for the Petroleum Industry" by Bolsover and Sewell describes developments in stainless steels with special reference to: (*a*) the beneficial effect of polishing; (*b*) stabilizing against weld decay; (*c*) the prevention of stress corrosion, and (*d*) low temperature properties.

Low alloy structural steels are also considered, with particular reference to the newer materials which have been developed for high temperature bolting.

A paper by Villain gives an account of the properties of modern high-alloy heat-resisting steels with special reference to: (*a*) corrosion by gaseous atmospheres; (*b*) creep, and (*c*) structural changes which occur after prolonged soaking at high temperatures.

The relative merits of casting, forging, and rolling are considered together with the effects of welding and the precautions required when welding these steels. Steels showing resistance both to abrasion and to sulphur are discussed, and the paper ends with examples of a cast bimetallic tube and a series of refractory plates for recuperators.

"Developments in the Use of Tantalum and Zirconium for the Petrochemical Industry", by van der Wateren, describes the preparation of pure tantalum, mentions the properties which affect its use, and describes the methods of fabrication and welding that have to be adopted on account of its price and rapid absorption of hydrogen. The main use of tantalum is for lining heat exchangers and re-boilers for use in sulphuric acid service. The corrosion rates in sulphuric acid are given for different flow velocities and improved designs of liners for this equipment are described. Zirconium is now becoming available at about one-sixth of the price of tantalum and since the corrosion properties of the two are comparable, laboratory tests are now being carried out to determine the best procedure for welding and fabricating zirconium equipment. For both metals further test results of corrosion under plant conditions are expected to be available for presentation at the time of the meeting.

A paper by Peake deals with the properties of aluminium and its alloys under the headings chemical resistance, physical and mechanical properties, and weldability, and shows how these properties make it suitable for a variety of applications in the petroleum industry. The applications are described under the headings building products, storage tank roofs, pipelines, sheathing for insulation, instrument-air tubing, condensers and heat exchangers, catalysts, heating coils in ships' tanks, road tankers, containers, and anodes for cathodic protection and paints. The paper recounts the practical experiences obtained in many of these applications.

Bastien and Amiot trace the history of hydrogen embrittlement from studies made during the last 50 years and summarize the symptoms and conditions under which it is likely to occur, with particular reference to the effect of hydrogen sulphide. They enlarge on the effect of (*a*) internal stresses, and (*b*) the structure and the heat treatment of the metal, both of which are illustrated by many micro-photographs. This section ends with a warning on the difficulty of interpreting laboratory tests. A type of nickel-chrome-molybdenum steel, which was investigated by the authors, is recommended as appearing to combine good chemical properties with good resistance to hydrogen embrittlement.

The corrosion properties and particularly the inter-granular corrosion of 18/8 steels with different carbon contents are discussed by Lilljekvist and Hansen who emphasize, by means of a graph, the rapid increase of corrosion in straight 18/8 annealed sheets as the carbon content rises above 0·06 per cent. The reasons for this are discussed with particular reference to the rate of quenching, the thickness of the sheet, and the effect of subsequent welding or heating within the critical temperature range. The effect of columbium and niobium on stabilizing steel and on corrosion resistance is discussed and the paper ends with recommendations of 18/8 steels for specific purposes.

Corrosion and Protection of Equipment

This section deals with corrosion and protection of equipment and includes one paper on corrosion inhibitors in plants, one on graphitization, one on the occlusion of hydrogen, one on the corrosion of underground pipes, and two on static electricity.

"Corrosion Inhibitors in Petroleum Processing Equipment" by Baxter, Bennet, and Hatchett refers to the types of corrosion encountered in processing equipment and the different methods used for controlling it. The authors then consider the economic advantages of preventing corrosion, with particular reference to the use of organic inhibitors for this purpose. They discuss the theory of the action, the methods of application, and the evaluation of the results; and quote the case histories which have been collected by them in a number of different plants over a period of four years. These serve to illustrate the authors' claims that organic inhibitors reduce the cost of neutralizers, have a

valuable detergent action which reduces the cost of cleaning, increase the life of the equipment, and in some cases permit the use of carbon steel where alloy steel was previously required.

"Graphite Formation in Petroleum-Refining Equipment" by Hall deals with the fundamental mechanism of graphite formation in steel and describes the research work on petroleum equipment which has been carried out by the Battelle Memorial Institute. In the course of this research some degree of graphitization was found in 299 out of 440 samples of steel which had been in service for over four years in different pieces of high-temperature refinery equipment. In only 28 cases was the degree of graphitization sufficient to cause failure in the bend test used for preliminary sorting of the samples. Further room-temperature tensile tests, and investigation of the mechanical composition of the steels showing severe graphitization, revealed that there was no simple relationship between the susceptibility of a steel and its content of aluminium, silicon, and nitrogen, but carbon-molybdenum steels show resistance and chromium-molybdenum steels are immune to graphitization. The general conclusion reached was that graphitization is fairly common in high-temperature refinery equipment but no failure attributable to it has yet occurred.

"Occlusion of Hydrogen in Steel" by Wilson, Bonner, Burnham, and Skei. This paper deals with current methods of predicting, detecting, and preventing hydrogen occlusion in those parts of refinery plants where steel is in contact with water and hydrogen sulphide at temperatures between 75° and 150° F. It reviews the conventional methods of protection by expendable linings of metal or ganister, and by water washing, and describes the authors' unsuccessful experiences with organic inhibitors. The paper then goes on to consider the protection afforded by polysulphides, discusses the mechanism of this protection, and enlarges on the practical methods of producing polysulphides *in situ*. The conclusion reached is that controlled air injection is the best method of doing this provided that the pH of the water is carefully controlled. Simple control tests for achieving this end are described.

"Corrosion of Underground Pipe in Urban Areas" by Hadley and Van de Water describes the greater complexities involved in providing protection for underground pipes in urban areas as opposed to rural areas. The present tendency is towards the use of thinner-walled pipe and part of the resultant saving is used to control corrosion by means of coatings and cathodic protection. The main types of pipe coatings are discussed together with the results obtained in practice, and the principles and main methods of applying cathodic protection to coated and uncoated lines are summarized. Attention is drawn to the difficulties arising from stray currents in urban areas and the possible danger to neighbouring buried structures. The need for co-operation with the owners of such adjacent structures is emphasized.

Klinkenberg discusses the production of static electricity by movement of fluids within electrically-grounded equipment. Because fluids in flow may carry an electric charge, the containers which receive them, even though earthed, may become charged to a dangerous potential. This fact is related to the high insulating properties of many petroleum products. Mechanisms which may give rise to electrostatic build-up are discussed and some operations which should be considered dangerous are analysed. The generation of electrical charges of high potential at interfaces, the separation of charges due to relative movement in an insulating fluid, and the precautions which may be considered or adopted as remedial measures, are described.

The protection of equipment in an oil refinery against electric discharges is discussed by d'Este. A high percentage of refinery fires is caused by sparks due to static electricity and in many cases the combination of circumstances leading up to sparking is completely unforeseen. Preventive action should aim at the most certain and complete means of protection. The formation of electrostatic charges is described and methods by which danger can be avoided, such as recognition of parts of equipment where build-up may occur, attention to the electrical continuity of such parts to earth, earthing systems, and personnel protection, are discussed. Lighting and lightning protective systems are considered for various classes of refinery structure.

SECTION VIII

Transport, Storage, and Distribution: Pipelines and Pipeline Terminals

Tanker Transportation

"Loss Control in Transportation and Storage of Petroleum and Petroleum Products" by McClintock discusses the magnitude of oil losses between the well-head and the consumer. It shows how these losses can be divided between each major phase of the journey and suggests basic principles and methods for their effective control.

Gasquet and Deschenes discuss the many factors which contribute to set a limit to the current tendency to build super-tankers. The size of a tanker depends on its draught: a draught of about 38 feet, corresponding to 48,000 dwt, though compatible with the present or future capacity afforded by the principal oil ports, is incompatible with Suez Canal navigability.

The final paper in this group, by Lamb and Strang, is devoted to those parts of an oil tanker's equipment which have a direct bearing upon the handling of petroleum cargoes. Quicker turn-round and port delays are dealt with, but it is considered that higher cargo handling rates introduce greater accident risks. Various improvements to a tanker's equipment which avoid such conditions are described. These include single and twin pump-room tankers, the rearrangement of pipes and valves in cargo tanks, and proposals for overcoming the risks attached to overheating of bulkhead gas-sealing glands.

Pipelines and Pipeline Terminals

In the first paper in this sub-section McMillin sets out briefly the objectives and modern layouts of marketing terminals, stressing the advantages of centralizing operations from a control bay, with the maximum use of modern measurement and communication methods. Engineers will undoubtedly seek in discussion more hard facts as to economies in time and materials.

Economic and technological considerations in recent Canadian pipeline developments are discussed by Fairlie and Lantz. The economics considered are very general and there

is no attempt to discuss future controversial extensions of the Canadian system. On the technical side, Canadian practice in design and construction forms the bulk of the paper, with the Mackinac and Hamilton harbour crossings and the pressure-reducing stations of the trans-mountain line discussed at the end. The Canadian pipeline industry has been bold both in its conceptions and executions and this paper, ranging over the whole field from planning to operation, should provide a basis for worthwhile exchanges of ideas on principles, as well as information on engineering details.

"The Design and Construction of Underwater Pipelines" by Green and List is a more detailed engineering study. The authors discuss, with examples, the three methods of laying underwater pipes, namely lowering from a welding work barge, buoyant launching from land, and the launching and manoeuvring from land of the entire line with slight negative buoyancy. Detailed technical details are given of the operations of the crossings at Lake Maracaibo and Coro in Venezuela and the Mackinac Straits in Canada, ending with a section on trenching. This paper will be of interest mainly to pipeline constructors.

In the fourth paper Ford discusses in some scientific detail results of recent investigations into the flow of viscous oils and their application to pipeline design. This is probably the first published account of the correlation between the cooling of heated oils in buried pipelines and the pressure required to move that oil—a combination of fluid flow and heat transfer. As the viscosities of marketed residual fuel oils have increased, more refiners, marketers, and buyers have become involved in the handling of viscous oils. This paper should therefore be of practical importance to all such people, as well as to producers of heavy crude oils.

Post-war developments in Italian pipeline construction with examples of specifications of pipes in present use and anti-corrosion techniques are discussed by Donati and Biffignandi. Emphasis is laid on matters which are of interest not only to pipeline companies but also to pipe manufacturers.

In the final paper the problem of safety in natural gas transmission and distribution is discussed by Salimbeni from the point of view of both the internal hazard for those who operate gas pipelines and the external hazard for those incidentally involved in danger, with a brief note on the economics of safety measures. With natural gas lines now in operation in many countries this is a subject which should interest not only oil company safety engineers but also Governments, local authorities, and insurance personnel.

SECTION IX

Economics, Statistics, and Education

Training and Management

Effective statistical analyses can provide the basis for better management decisions on many complex management problems. They should seek the whole truth and must start with an understanding of the data and consideration of all the facts pertinent to the problem. This is the thesis put forward by Gonzalez in the opening paper of this Section.

Presentation to management, the author states, should bring out the essential points quickly. Starting with a brief summary of the problem and conclusions, the report should select and arrange data to convey meaning quickly and avoid discouraging the reader with massive tabulation. Visual aids should be used in oral presentation. The systematic application of statistical analysis in business is relatively new, and can make a creative contribution to the management of business and to the better functioning of the economic system.

Education for management in the petroleum industry is discussed by Maloney who states that it is becoming accepted that the art of management is susceptible to guidance. A manager's task is to get jobs done by people, as the petroleum industry is especially aware. Education in human relations is widely featured in the U.S.A. and is spreading to other countries. Management development consists of selection and training—selection is being studied and will improve, while training includes the provision of selected opportunities for practical self-education. Future managers must grasp the importance of individual loyalty and sense of participation, and will also have to deal with groups of people. Education which emphasizes the need to understand people can meet the challenge of providing competent managers for the petroleum industry.

"The Independent Consultant and the User of Petroleum Products" by Temby and Ruffell is the final paper in the first half of this Section. Temby and Ruffell describe how, in the postwar period, the Petroleum Section of the Australian Defence Standards Laboratories has assumed the role of independent consultant to marketers and users of petroleum products in Australia. The knowledge gained in wartime has enabled a technical service to be given comparable with the best the local oil companies could offer. This service has the advantage of being commercially disinterested and the convenience of being set up within the framework of an existing government organization which is dealing with similar problems in the military field. The staff need the widest possible technological background and recruitment is very important. The attributes of both the technical college and the university man are required in the petroleum consultant.

Technical Aspects of Economic Problems

In "Oil and Gas Conservation in Venezuela" Battisti, Vasquez, and Herrera discuss the progress made in Venezuela towards the conservation of oil and gas and cover the philosophical, technical, legal, and economic aspects of this problem. Conservation is accepted in Venezuela as sound and efficient oilfield practice and the use of modern techniques is continually in progress. One of the problems being faced is the conservation of the large volume of by-product gas associated with oil production. Co-operation between the Government and the industry has avoided the necessity for restrictive legislation or close Government control.

Discussing interdependence as the foundation for world oil operations, Levy points out that there are four principal types of participants in world oil operations: the producing and exporting countries, the international oil companies, the consuming countries dependent on oil imports, and the parent countries of the oil companies. An effective functioning of the world oil economy is possible only through the joint endeavours and the continuous contributions of all the participants.

A paper contributed by Frankel deals with the role of fuel oils in Europe and examines the demand and supply curves for energy for the years up to 1968. Unless new sources of

energy, such as atomic energy, can play a significant role in this period, only fuel oils can fill the widening gap between available coal and hydro-electric power and the demand for energy. For the oil industry this is a problem of refinery economics and the probable effects on yield patterns and crude oil prices are discussed in this paper.

The legal problems involved in the conflict in Italy between the requirements of concerns laying methane piping and the rights of the owners of property across which the piping is laid are discussed in a contribution by Ilardi.

"The Utilization of Petroleum Fuels in Europe", "Past and Future Trends in Energy Consumption in Italy", and "The Place of Oil and Natural Gas in the European Energy Economy" are the titles of the last three papers in this Section.

Holaday and Albright analyse the past and future energy, pattern for Western Europe and compare it with that of the United States. The factors affecting selection and the most efficient use of petroleum fuels in various fields are described, and a change in the pattern of European fuel use towards a higher percentage of gasoline and distillate fuel and a lower percentage of residual fuel is postulated.

The final paper by van den Heuvel is a survey of the part played by petroleum fuels in the energy pattern of Western Europe (O.E.E.C. member countries). A forecast to 1965 shows the estimated energy requirements and the increasing share expected from oil and natural gas. Mention is made of the effect of the price paid for energy on demand and the harm done by the indiscriminate taxation of petroleum products.

★ ★ ★

Personal Notes

Sir Edward Bullard, F.R.S., has resigned from his position as director of the National Physical Laboratory and is to return to Cambridge University as head of the Department of Geodesy and Geophysics—a position which he held before 1948.

Sir Edward is a graduate of Cambridge University and continued working there on geophysics until the last war. After the war he returned to Cambridge as a Reader in Experimental Geophysics until 1948 when he was appointed Professor of Physics at the University of Toronto.

Sir Edward has organized research all over the world on a range of problems which are of particular importance to the oil industry, such as seismic methods of studying strata of the earth's crust on land and sea and problems of terrestrial magnetism.

J. R. Suman, a vice-president and director of Standard Oil Company, New Jersey, retired at the end of March after 44 years' service in the petroleum industry.

Mr Suman is well known as a geologist, engineer, and executive. He played a large part in the development of the modern rotary drilling rig and shared in pioneering the unitized drilling rig.

After graduating, Mr Suman worked with the Rio Bravo Oil Company at Houston as assistant geologist and later as chief engineer. He then joined the Roxanna Petroleum Corporation for two years before returning to Rio Bravo as assistant to the vice-president and general manager. In 1925 he was appointed vice-president and general manager.

Mr Suman joined the Humble Oil and Refining Company of Houston, a Jersey Standard affiliate, in 1927 as a director and became vice-president in charge of production in 1933. He was elected vice-president and director of Jersey Standard in 1945 and became a regular member of Jersey's Executive Committee in 1946.

E. R. Blane, F.Inst.Pet., has retired from his position as associate technologist at the Vacuum Oil Company's Central Laboratories at Wandsworth after serving the Company for over twenty years. He is to remain with the Company for a limited time, however, as a full-time consultant. Mr Blane first joined the Company in 1934 as a salesman-chemist in the Tanners' Department. He was transferred to the Technical Department in 1938 and was later appointed technologist in the field service of the Department. In 1953 he was transferred to the Central Laboratories.

Mr Blane has been responsible for original work on process products while he has been with the Vacuum Oil Company, particularly on wax emulsions, tanners' products, and cutting and rolling oils.

Vacuum Oil Company's chief automotive engineer, **O. T. Jones,** B.Sc., M.I.Mech.E., retired recently after thirty-five years' service with the Company. Mr Jones joined Vacuum in 1920 and became chief automotive engineer in 1925. He has lectured extensively and has been particularly interested in all aspects of technical training.

Mr Jones is succeeded by C. G. Tresidder, A.M.I.Mech.E., A.F.Inst. Pet. who joined the Vacuum Oil Company in 1946.

J. H. Evans, M.Inst.Pet., has been appointed chief metallurgist of the British Timken Organization.

Sir Kenneth Harper, chairman of the Burmah Oil Company flew to Karachi recently to inspect the new Sui gas installation. Included in his journey was a visit to Bombay for the opening of the new Shell refinery.

L. G. Packham has been appointed to the Board of Directors of C. C. Wakefield and Co. Ltd. Mr Packham is overseas general manager of the Company and will continue to hold this position. He is also a director of C. C. Wakefield and Company (Ireland) Ltd. and Castrol Oils (Canada) Ltd., and a member of the Council of Advisers of the Company's German and Austrian associates.

Mr Packham joined the company 30 years ago and was manager of the Overseas Branches Department until 1952.

Esso Appointments

The Esso Petroleum Co. Ltd. recently announced the following appointments:

G. Stedman, previously district manager, has been made costs and operations manager, London Division. **T. E. R. Bray,** formerly assistant to the regional manager (South) has succeeded Mr Stedman.

F. W. Ellis, who was manager, kerosine and merchandise, Retail Sales Department, has been appointed district manager, Nottingham, and is succeeded by **T. A. Clift,** manager, kerosine and merchandise, Scottish Division.

The Outlook for the Oil Industry*

By G. P. GLASS† (Associate Member)

The World Energy Picture Today

The Growth of Oil as a Source of Energy

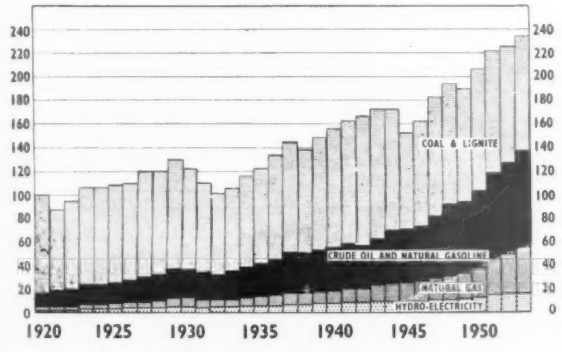
The industrial revolution of the nineteenth century was based on coal, but since the first world war the pattern of world energy supplies has changed and coal as a commercial source of energy has been increasingly complemented by hydro-electricity, natural gas, and, above all, oil.

By 1953, coal had lost the predominant position in world energy supplies which it had held in 1920. As will be seen from Chart I, the total volume of commercial forms of energy in 1953 was some 2¼ times that of 1920. Over this period, the share of oil (including natural gas) increased from 15 to 50 per cent and the relatively small contribution of hydro-electricity also increased. But although the absolute quantity of coal consumed increased, coal's share of the total declined from 83 per cent in 1920 to 43 per cent in 1953. (These figures‡ are illustrated in Chart II.) Thus oil is now the principal commercial source of energy for the world as a whole.

Chart I

The Changing Pattern of World Energy Supplies

Indices (1920=100)



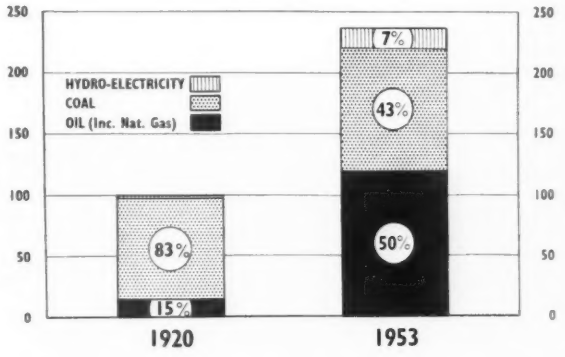
The growth in the importance of oil in the world energy picture has been due to many factors, of which one of the most important has been the development of road and air transport. As Chart III shows, the world's fleet of motor vehicles has risen from about 9 million units in 1919 to about 76 million in 1953. The amount of air traffic has also greatly increased, particularly in the last 15 years.

Another important factor stimulating oil demand has been the recognition of the superiority of oil in certain uses, for example in shipping. In 1914, almost 90 per cent of world merchant shipping was fuelled by coal. By 1953, the total merchant shipping tonnage had almost doubled and over 86 per cent was oil-fired. This change is illustrated in Chart IV.

Chart II

The Changing Pattern of World Energy Supplies

1920=100



The Outlook for Energy

Demand

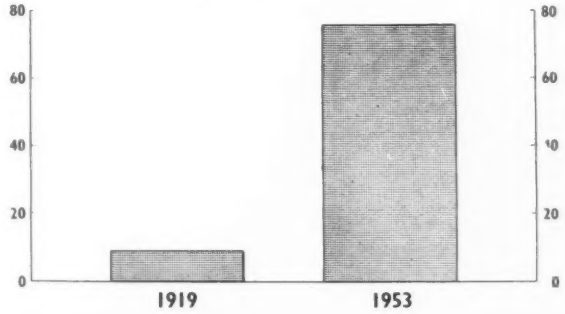
The scope for the development of any one type of energy is intimately bound up with energy developments in general. The outlook for the oil industry is, therefore, closely connected with the outlook for energy as a whole and with the prospects for the other main sources of energy. In the foreseeable future the upward trend in the world demand for energy may be expected to continue in the absence of another major war or severe economic depression. It is now generally considered that an economic depression on the scale of the early 1930s is unlikely to recur in so far as enough is now known about economic techniques for combating the down swings of the trade cycle to prevent such swings from leading

Chart III

*World Motor Vehicle Population**

Millions of Consuming Units

Figures on 1 January



*Cars, trucks and buses.

---

* Paper read to the Institute of Petroleum, Stanlow Branch, 19 January 1955.

† Shell Petroleum Co. Ltd.

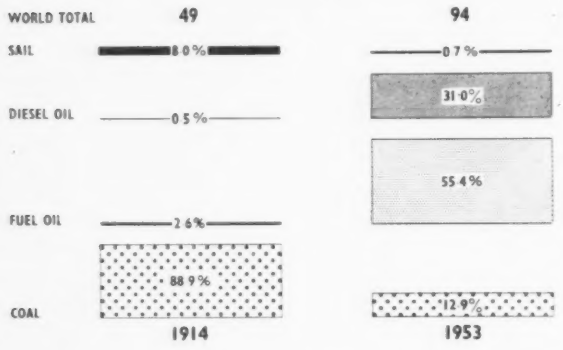
‡ These figures refer to the effective consumption of energy, that is, they allow for efficiency in use.

Chart IV

World Merchant Shipping

Showing Increasing Use of Fuel Oil and Diesel Oil

Million tons gross



to economic chaos. The second assumption can only be based on the reasonable hope that the ravages of another major war can be avoided.

Some idea of the scope for the long-term expansion of energy demand can be gained by looking at the present distribution of the world's production and consumption of energy in relation to the distribution of population. Energy production and energy consumption are both concentrated largely in North America, Western Europe, and the Soviet sphere (excluding China), in contrast to the concentration of population. The position is illustrated in Chart V.

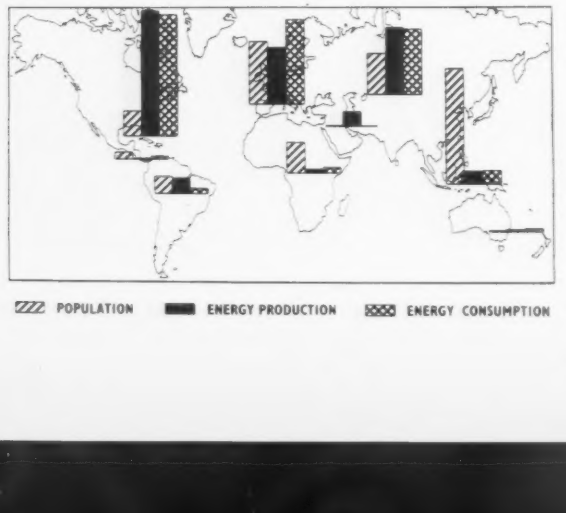
To take the two extremes—in North America 8½ per cent of the world's population consumes over 40 per cent of the world's energy supplies; on the other hand, in South-East Asia (excluding China) 38 per cent of the world's population consumes only 4 to 5 per cent of world energy supplies.

A large fraction of the world's population is engaged in subsistence farming. This fraction may be expected progressively to make the transition from illiteracy and subsistence farming to literacy and an industrial-*cum*-agricultural pattern of life. In the past, such a transition has been accompanied by a population increase because the decline in the death rate has generally preceded the decline in the birth rate. There is no reliable reason for believing that this relationship will alter in the future. On the other hand, the population of the world cannot rise substantially unless most of the illiterate subsistence-farm groups achieve a measure of mechanization and a higher production of food. Such achievements imply a high demand for energy.

Chart V

World Population and Energy 1953

Percentage of World



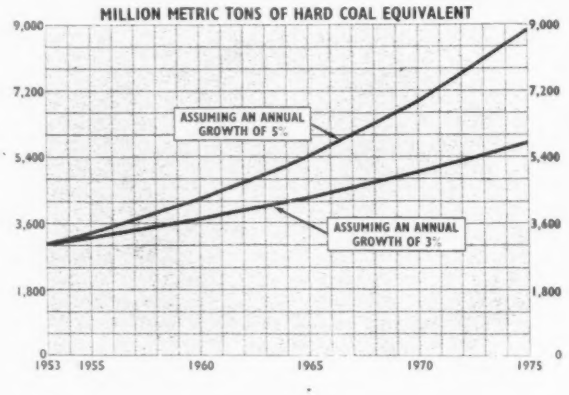
In the past, the growth in the average world demand for energy per head has been weighted by the demand of a few hundred millions in the industrialized West. In the future, consumption may be swelled not only by further demands from the West but also by rapidly increasing demands from many hundreds of millions in such currently under-developed areas as South America, Asia, and the Far East, where U.S. and U.N. development schemes are encouraging and accelerating development in many countries. In the aggregate, these programmes may enable the rest of the world to develop more rapidly than the West did during the first half of this century.

Some idea of the huge demand for energy of all types which may materialize in the next 20-odd years can be gained from Chart VI.

The lower line on the chart shows how the world's consumption of energy will increase over the years 1953-1975 on the assumption that the rate of growth is 3 per cent per annum. This level of consumption may be regarded as a fairly realistic lower limit if positive economic expansion continues in the world as a whole and if there is no major economic, political, or military upheaval. The upper line on the chart indicates a possible upper limit to energy consumption in this period; it assumes a high rate of growth of 5 per cent per annum.

Chart VI

Estimated World Consumption of Energy 1953-1975



Supply

The prospects for energy supplies in the future need to be considered, therefore, in the light of an expected buoyant demand for energy.

Coal

Coal production is not expected to increase significantly in the next 20 years. The upward trend in coal and lignite production over the last 30-odd years has been slight, as shown in Chart VII. In 1953, total production was about 1564 million metric tons of hard coal equivalent, compared with 1293 million in 1920. These figures indicate that production is tending to stagnate.

Increased coal production is hampered by many problems, including increased difficulties of extraction as the most easily accessible seams are worked out, the considerable time-lag between the decision to commence new working and the actual production of coal in quantity, the necessity for heavy capital investment to permit the use of modern methods and equipment, and problems of labour supply under conditions of rising living standards and full employment in many countries and a shortage of skilled mining engineering staff. It would therefore appear that one cannot look for any

substantial increase in world coal production above its present level.

Hydro-electricity

Hydro-electricity is essentially a source of energy which can be tapped only where the appropriate geographical conditions exist. In the last 30-odd years hydro-electric development has made appreciable strides forward in certain areas—*e.g.* in Western Europe it has advanced considerably since the end of the second world war. However, the percentage contribution which hydro-electricity makes to world energy supplies is still only 7 to 8 per cent. For the future, while hydro-electricity may be most important in some cases where adequate indigenous sources of other forms of energy are lacking, and while its contribution to world energy supplies may be marginally important, a significant increase in its relative importance should not be anticipated.

Atomic Energy

Undoubtedly, the longer-term outlook for energy supplies has been substantially altered by the fact that the peaceful harnessing of atomic power is now technically possible. While atomic energy may become an economic and commercial reality within about a decade, it is unlikely to contribute substantially to world energy supplies in that period.

It is reasonable to assume that by 1975-80 atomic power will be used to some extent for the production of electricity in, for example, the United Kingdom, the United States, and, on present indications, Russia, and perhaps also in countries which depend upon imported supplies of fuels for power stations in so far as they can find a means of financing the heavy capital cost of atomic power development which, at the moment, is above that for conventional power development. By that time, it may also be used to some extent in shipping, at least for military purposes. While it is difficult at this stage to be more explicit, it seems reasonable to assume that over the next 20 to 25 years atomic energy is unlikely to make a very significant contribution to world energy supplies as a whole.

The Outlook for Oil

Demand

There does not seem much doubt that coal and oil will continue to supply the bulk of the world's energy needs in the short term. In the light of the prospects for coal production, one can go further and suggest that in the next decade it is largely to oil that one must look to ensure that the world's demand for energy does not go unsatisfied.

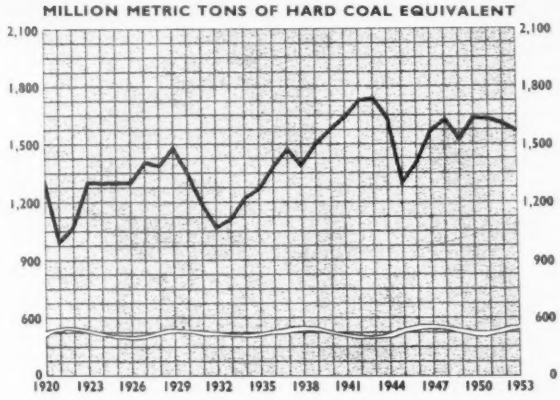
The same general proposition holds good for the next 20 years and there can be little doubt that a great effort will be demanded of the oil industry to ensure that adequate supplies of energy are available to meet the expected demand.

In this context, it is interesting to look at the picture of free world petroleum consumption in 1975 painted by the U.S. Paley Commission on Raw Materials Policy and to compare it with the actual position in 1953. As Chart VIII shows, by 1975 oil consumption in the main consuming areas of the free world, namely the U.S.A., the rest of the Western Hemisphere, Europe (that is Europe outside the Soviet sphere), and the rest of the Eastern Hemisphere, is expected to have greatly increased. For the free world as a whole it may be more than double its 1953 level.

Over this 20-year period, the pattern of oil demand may change, at least in the large area of the free world outside the U.S.A. If oil is called upon to supply an increasing proportion of the world's energy needs it is upon the black oils that the additional demand will fall most heavily. Historically this tendency has already asserted itself. In the world outside the U.S.A. and the Soviet sphere the volume of oil consumption nearly trebled over the period 1938-1953, during which time the share of the black oils in total consumption rose from 50 to 59 per cent. There may be a tendency for this trend to continue. There is a problem here in that there is a limit to the extent to which conventional refining operations can be adjusted to produce a larger output of the black oils. Normally an increased supply of the black oils will be accompanied by an increased supply of the lighter products for which, as Chart IX indicates, demand is not increasing at the same rate.

Chart VII

World Coal and Lignite Production 1920-1953



Supply

The oil industry has always taken the view that, given reasonable freedom of action, it can meet the demands made upon it. It is well placed to do so, not only because of its inherent flexibility and "know-how", but also because of the large oil reserves of the world.

In January 1954 the proven oil reserves of the free world amounted to about 18,000 million tons of crude oil. This figure for reserves is far less than that for possible reserves and, indeed, the amount of oil still awaiting discovery may well be sufficient to meet the needs of the world well into the next century. Despite the huge tonnages of oil produced annually, the oil industry is discovering each year new reserves at least equal to those lost through production.

As Chart X shows, 61 per cent of the free world's total proven oil reserves are now in the Middle East. This is likely

Chart VIII

Estimated Free World Petroleum Consumption

1953 and 1975

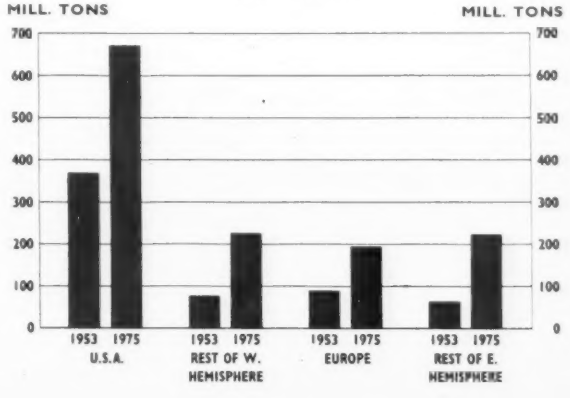
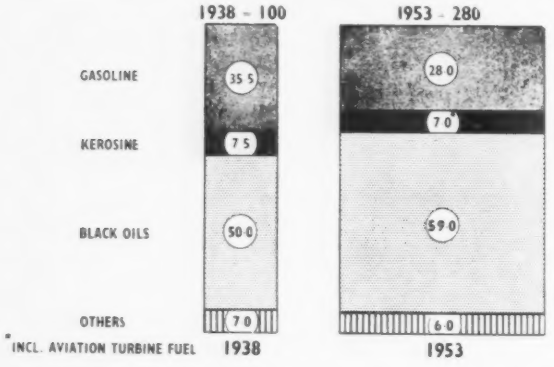


Chart IX

The Pattern of World Oil Consumption

Excl. U.S.A. and Soviet Sphere

Figures in Percentages by Volume



to affect the movements of oil in international trade in the future, as, indeed, it has done in the recent past. In 1953, oil from the Caribbean largely supplied the net import requirements of North America and sizeable tonnages also moved from the Caribbean to Western Europe (although nearly four-fifths of Western Europe's oil already came from the Middle East). The Paley Commission envisaged that by 1975 Western Hemisphere producers outside the United States would not have an exportable surplus sufficient to meet higher U.S. import requirements alone. There seems little doubt, therefore, that both the United States and Western Europe will have to look to the Middle East for even larger tonnages of oil in the future.

Essential Factors in the Future Oil Position

While, by its nature, the oil industry is fitted for the huge task that lies ahead, there are, nevertheless, certain problems which it will have to face in meeting the future demand for oil products.

The Taxation of Oil Products

Firstly, there is the problem of the taxation of oil products. Heavy taxation applies primarily to gasoline but in some countries it applies also to automotive diesel and even to industrial gas oil and fuel oil. Such heavy taxation of a basic necessity is both misguided and inequitable. In the case of gasoline and automotive diesel it involves raising transport costs which are themselves essential costs in industry and agriculture. Hence it in fact means increasing the general cost of living. The folly of taxing gas oil or fuel oil used for industrial purposes is readily apparent in view of the expected demand for these products in the context of increasing energy demand and stagnating coal production.

There is, however, one aspect of the taxation of the lighter products which is particularly noteworthy. Reference was made earlier to the fact that the flexibility in refining processes and product yields which the oil industry has been able to achieve is not unlimited. High gasoline taxation is one factor which, by restricting the demand for gasoline, helps to set a limit to the total refinery throughput of crude oil in order to avoid the excessive production of gasoline. Since the heavier products are jointly produced with gasoline, their output is likewise restricted. This is a particularly unfortunate result of high oil taxation at the present time when in the free world outside the U.S.A., and especially in Western Europe, the anticipated increase in energy demand may well be associated with a rise in the relative importance of the black oils.

The Financial Problems of the Oil Industry

The financial problems which have faced the oil industry have always been formidable and are likely to become more so, rather than less so, if oil is called upon to ensure that the world's energy needs are satisfied.

The running of a world-wide oil business requires a large programme of continuous capital investment to meet both the growing demand for oil products and the modernization of plant to take advantage of new scientific knowledge. It is estimated that, from the end of the war, capital investment by the companies in the world oil industry has totalled over £10,000 million. Staggering though this figure is, it can be put into some sort of perspective by considering certain individual items of expense which have gone to make it up. The Trans-Arabian pipeline network cost $215,000 per mile or $230 million in all. In the U.K., almost £200 million have been invested in the construction of refineries since the war. A general-purpose tanker of 18,000 dwt today costs over £1 million and super-tankers of over 45,000 dwt cost over £2 million.

These costs have been greatly increased owing to wartime and post-war inflation. It has been estimated, for example, that the cost of line pipe in this country has doubled, of steel tankage has nearly trebled, and of centrifugal pumps has considerably more than trebled since before the war. It is also estimated that whereas over the period 1939-1953 capital expenditure by 30 major U.S. oil companies totalled over $25,000 million, if general costs and prices had remained at their pre-war levels these companies might have undertaken the same programmes of development and expansion with an expenditure of the order of only $12,000 million.

In the years ahead, the oil industry is likely to face a truly stupendous capital charge for new facilities alone. It has recently been estimated that the capital cost of facilities required to transport, refine, store, and distribute one additional barrel of crude oil daily could be of the order of £1000 at current prices. The expenditure to find and produce this additional oil may amount to as much again, depending on the actual geological and geographical conditions, so that in the next few years products marketed from every additional barrel per day of crude may involve the oil industry in capital expenditure of as much as £2000.

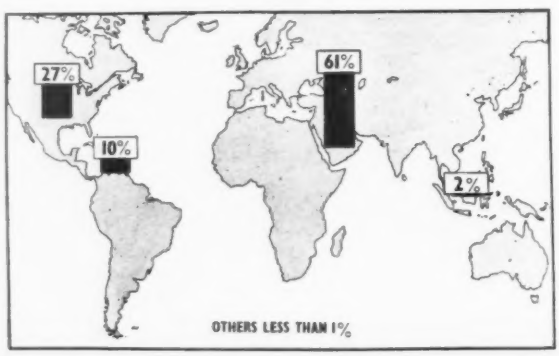
In terms of capital expenditure per annum, one estimate has been made which suggests that capital expenditure by the free world oil industry may amount to £2000 million a year for many years to come.

The oil industry obtains its capital from two main sources, that is from retained cash earnings and from the world's

Chart X

Free World Proven Oil Reserves, January 1954

17,770,000,000 Tons



capital markets, but traditionally it has found it advantageous to rely largely on its own earnings to provide for capital needs on the huge scale required. In the United States a group of 30 major oil companies has normally retained more than half its annual net income in the business since 1941. In the case of the major U.K. oil companies the percentage of profits retained has been considerably higher. There seems little doubt that in the future the practice of self-financing from retained earnings will have to continue, since it can hardly be expected that the capital markets of the world will be able to provide finance on the scale required.

Inflation has not only increased costs but has also intensified the problem of acquiring the necessary capital for expansion. This problem has also been greatly aggravated by high corporate taxation, which is by no means historical. Hence the need for adequate oil prices and earnings in the future.

To sum up: if, in the years ahead, the world escapes from economic, political, and military disaster, then it can confidently be predicted that the world demand for energy will continue to increase and that the demand for oil will be generally buoyant. It seems probable that over the next 20-odd years the oil industry will be asked to carry much of the burden of making available the extra supplies of energy needed if general economic progress is to continue. In return, the oil industry asks that it should be allowed reasonable freedom of action, adequate prices for its products, and that it should not be hampered in its operations by illogical taxation policies. In such circumstances, it may confidently be expected that the industry will prove equal to the demands made upon it.

★ ★ ★

Books and Films

The Production of Oil

Three of a quartet of films dealing with the production of oil have been produced recently by The Shell Petroleum Co. Ltd. The films are entitled "The Changing Earth", explaining the basic geology of the formation of oil, "The Search for Oil", dealing with prospecting, and "The Wildcat", which shows the drilling of an exploratory oil well.

The first of these films is introductory, animated diagrams being used to great effect to illustrate the changes which occur in the earth's crust over long periods of geological time. "The Search for Oil" is particularly scenic, set as it is in the forests of Indonesia, but nevertheless instructive in its description of methods of gravimetric and seismic exploration. The last film in this trio (the fourth film in the series, "The Oilfield", is expected to be available soon), shows the work involved in drilling a well, from "spudding in" to the flowing of oil.

Bert Haanstra, the Dutch film director who produced these films with a joint Dutch and Indonesian team of technicians under the general supervision of Sir Arthur Elton, film adviser in London to the Royal Dutch/Shell Group, is to be complimented on his coupling of imaginative treatment with technical instruction. Shell films in general are invaluable to a lay understanding of petroleum production for they can be relied upon to show clearly the principles on which equipment and processes operate—in these films, for instance, the gravimeter and the underground effects of well-drilling procedure are particularly well treated. This virtue, coupled with the antics of wild-life and the emphasis on location, make these notable documentaries.

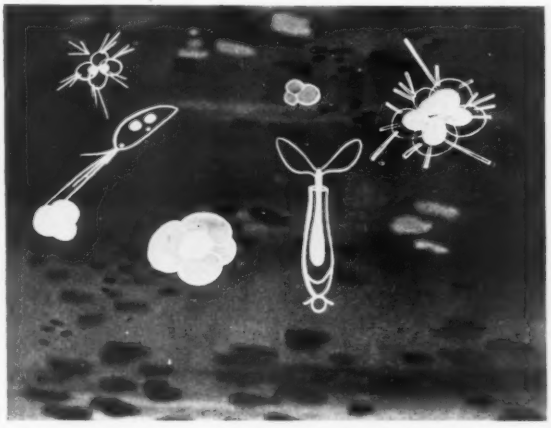
Running times are 9, 31, and 33 minutes respectively, and copies in both 33 mm and 16 mm gauges are available on loan from the Petroleum Films Bureau, 29 New Bond Street, London, W.1. The films will be distributed overseas through Shell Companies.

Petroleum Facts and Figures

Now in its eleventh edition, this API statistical volume of over 300 pages brings together a mass of valuable and authoritative data, particularly in regard to petroleum production and consumption in the United States. From it, it is possible to glean information relating to almost every aspect of oil consumption, *e.g.* motor fuel use by States, sales of fuel oil by users, motor fuel consumption by aircraft, motor vehicle registrations, use of petroleum in wood preserving, etc., etc. New material in this edition includes marketing flow charts for motor fuel and for fuel oil, data on petrochemicals and on employment, and information on offshore operations and on sales of lubricants.

World figures include details of production, refining, and marketing and of motor vehicle registrations. In the miscellaneous section, figures for the heat values of various fuels are given with other useful tables.

Price of this volume is $2·00 and copies are available from the API at 50 West 50th Street, New York 20, N.Y., U.S.A.



An animated diagram from "The Changing Earth". Plankton, minute living organisms in the sea, fall into layers of silt on the sea-bed and through geological time turn into oil.

Petroleum in India

An illustrated booklet entitled "Petroleum in India" has been written by P. Evans, chief geologist of The Burmah Oil Co. Ltd. It tells of the search which is being made in India for oil deposits in addition to the Digboi field, and of the considerations governing the geophysical and drilling programme undertaken by the Assam Oil Company.

The geological history of Peninsular India has not provided suitable conditions for the formation and preservation of oil. In the regions fringing the Peninsular the most promising area is that extending from Tripura to Upper Assam and there exploration has been most active. It is in that area that the important Digboi and Nahorkatiya oilfields have been found.

Recent Development in Diesel Engine Research*

By **PROFESSOR F. MORTON, Ph.D., D.Sc.† (Vice-President)**

The diesel engine is a compression-ignition engine. During the suction stroke air is drawn into the cylinder and subsequently compressed by the upward movement of the piston. As the air is compressed its temperature rises and at a point towards the end of the stroke, usually from 10 to 5 degrees before top dead centre, liquid fuel is injected into the hot compressed air. The air may reach a temperature as high as 500°C and this is sufficiently high to ignite the fuel. Burning of the fuel produces an expansion of the gases which forces the piston downwards doing work. At the end of this stroke the exhaust valve opens and as the piston travels upwards the exhaust gases are pushed out of the cylinder until at top dead centre, when the air inlet valve opens and the exhaust valve closes, the cylinder is free of exhaust gases and the cycle is then repeated.

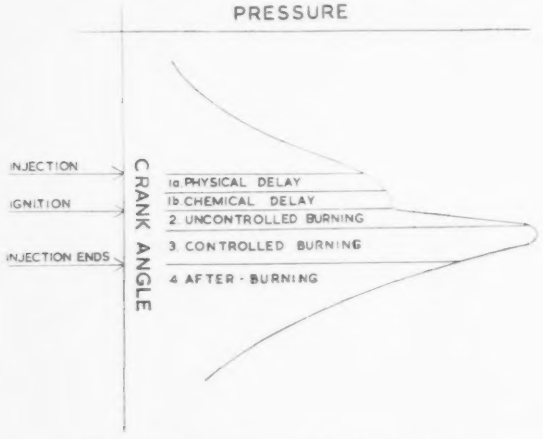


Fig. 1. *Indicator diagram for diesel engine.*

The fuel does not begin to burn immediately the injection commences, in fact there is a delay period between injection and ignition, the length of this period being dependent upon fuel quality, engine design, engine load, and other variables. The sequence of events in the engine over the period of injection and ignition can best be illustrated by a pressure–time diagram (Fig 1) in which the cylinder pressure is plotted as a function of the crank angle position. The cylinder pressure rises normally up to the point of injection and continues to rise normally until ignition begins. From this point the pressure rises rapidly for a period during which the fuel burns in an uncontrolled manner. Thereafter the pressure falls gradually through the power stroke and the fuel burns in a controlled manner.

In order to minimize the delay period and to reduce the period of uncontrolled burning during which the cylinder pressure may rise to an undesirable level, various modifications have been made to the cylinder head in order to obtain better mixing of air and fuel. In the direct injection engines the air is made to swirl by means of shrouded valves or by depressions in the piston head. In other engines, the fuel is injected into a pre-combustion chamber or swirl chamber which is an extension of the cylinder head and into which the compressed air is forced in a swirling motion. In all these engines the object is to facilitate the ignition of the fuel, to reduce the delay period, and so to limit the rise in pressure which occurs during the period of uncontrolled burning.

The diesel engine is one of the most efficient engines in which the heat energy in a petroleum fraction is converted into useful work. It has found wide application in industrial and marine installations and is the most popular power unit for the larger size of commercial vehicle, both bus and lorry. The smaller diesel engine is widely used for small commercial vans and agricultural tractors. The high pressure rise during the uncontrolled burning period makes the design of a light-weight high-speed diesel engine a difficult problem and unless this pressure is controlled the engine is noisy and rough running. The use of the light-weight high-speed diesel engine as the power unit for private motor cars has aroused considerable interest and, although major improvements in the diesel engine will be necessary before it can compete with the petrol engine, several models have already appeared. At present it would appear that the higher initial cost of the diesel engine will outweigh the advantages of lower fuel consumption.

Diesel engine research during the past few years has been aimed at increasing the power output and decreasing the weight of the engine. In the large industrial and marine diesel installations where weight is not of paramount importance interest has centred around the utilization of the heat energy available in the exhaust gases. In marine installations this heat is used for water heating and steam raising but the modern tendency is to increase the power output of the engine by using the exhaust energy to drive a turbo centrifugal supercharger. By this means a greater quantity of air is introduced into the engine and this makes possible more complete combustion of the fuel. The medium-weight diesel engines used in heavy road transport are limited in overall size and weight by law, and must operate so that "no avoidable smoke or visible vapour is emitted". This limits the power output of the engine since the "smoke" content of the exhaust increases with the load. The smoke is caused by incomplete combustion of the fuel and is affected by engine operating conditions and by fuel quality. Much effort has been directed towards a satisfactory solution of this problem.

For the development of high-speed (2400 r.p.m.) light-weight diesel engines it will be necessary to provide conditions such that the delay period is minimized and the pressure rise during the first period of burning is controlled. Although some reduction in the delay period may be achieved by modified engine design, particularly in the fuel injection system, thus minimizing the "physical delay" period, major improvements must be sought in the combustion of the fuel, either by improved fuel characteristics or by the use of fuel additives. A great deal of effort has been spent in a search for suitable additives and several chemical compounds, such as

*Lecture given to the Institute of Petroleum, Fawley Branch, 27 September 1954, and the Trinidad Branch, 11 January 1955.

†Department of Chemical Engineering, University of Birmingham.

*iso*propyl nitrite, tertiary butyl peroxide, etc. have proved of value. Ultimately, however, the problem must be related to the chemical reactions taking place in the engine cylinder at the moment of injection. This is the problem upon which work is being carried out at Birmingham University.

Investigations concerning the pre-flame reaction in a diesel engine had been carried out using a single-cylinder Crossley engine fitted with a Comet Mark II swirl chamber. Conditions in the swirl chamber during the injection of the fuel are extremely complicated (Fig 2). As the fuel is injected into the hot swirling air, liquid droplets are torn off from the spray and move with the air swirl. Some of the droplets will vaporize and at some point in the swirl chamber, probably on the wall of the chamber opposite the point of injection, the fuel will burst into flame. The flame travels round the swirl chamber in the same direction as the moving air and the heat so generated vaporizes the liquid fuel in the chamber, which then burns rapidly giving rise to the marked increase in pressure so characteristic of the diesel engine. Once the excess fuel in the chamber has been burnt the rest of the fuel burns smoothly as it is injected until injection of fuel ceases.

The events and reactions occurring during the delay period can be followed by several means. At Birmingham three principal techniques have been used in this study. First, sampling valves have been designed which permit withdrawal of gas samples from the swirl chamber at various positions of crank angle and subsequent analysis of the gases to determine the amounts of intermediate and final products of combustion. Secondly, by the careful measurement of pressure within the swirl chamber, the variation in pressure and temperature during the delay period with various injection settings has been studied. Finally, use has been made of a window in the swirl chamber connected to a photo-multiplier unit to record the appearance of flames within the chamber and to study the variation in pre-flame and full flame character with fuel quality and injection setting. Each of these investigations has provided valuable information concerning the pre-flame period—the period prior to injection and between injection and ignition—and has indicated some relationship between the events in this critical period and the quality of the fuel.

In 1952 an account was given of a hydraulically-operated mushroom-type valve designed by E. P. Wright which was used to withdraw samples of gases from the swirl chamber of the Crossley engine. The valve opened over 2° crank angle and the point of opening could be varied over the entire engine cycle. Unfortunately the amount of gas flow was very small and the collection of sufficient amounts of gas to give a measurable concentration of aldehydes and peroxides in the absorption trap required considerable time so that a complete sampling run from −15° to +5° crank angle, with one fuel at one injection setting, sampling every 2° crank angle, required about sixteen hours. It was possible, however, to show that aldehydes and, to a lesser extent, peroxides were formed in the engine during the delay period and reached a maximum at the point of ignition, also that the amounts of these pre-flame intermediates differed according to the character of the fuel. Repeat experiments with the same fuel showed that the results could be reproduced despite the heterogeneous conditions within the chamber.

About this time other workers described the use of an electro-magnetically-operated needle valve in sampling experiments in a spark-ignition engine. The opening of the valve by a "hammer"-like impulse gave a more positive opening than was possible with the hydraulic mechanism and, although the application of this mechanism to a mushroom-type valve required a much heavier impulse, it was decided to modify the valve in this manner. Fig 3 shows a cross-section of the valve designed by W. D. Reid, the stem and body of which were made of 3 per cent nickel steel, with

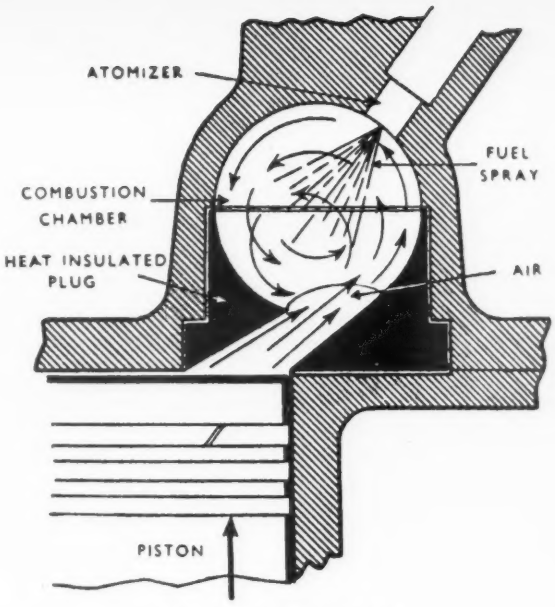


*Fig. 2. The swirl chamber.**

the valve head and seat (Q) stellite-faced. The valve stem was supported in a tufnol guide (R) and was spring-loaded by a strong compression spring (D), held in position by the tufnol collar (E). This was locked in position by a mild steel anvil (G) screwed to the end of the valve stem. The hammer, consisting of a mild steel core (L) and a brass striking pin (M), was accelerated by a transient magnetic field produced by the solenoid (K). The hammer moved in an axial direction, struck the anvil, and was then returned to its original position by the spring (T). The tension in (T) could be adjusted by the screw (P) and the movement of the core was limited by the adjustable stop (N). The close fit of the anvil and the hammer in the guide (S) ensured that the valve stem moved only in an axial direction during operation. When the valve opened the

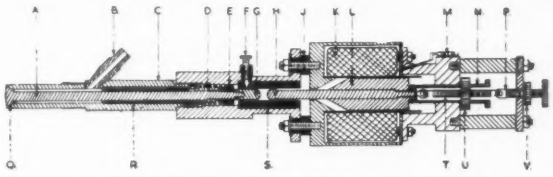


Fig. 3. Electromagnetic gas sampling valve.

sampled gases passed down the annulus between the valve body and stem and out through the tube (B). To reduce the time of flow through the valve, an asbestos bush was fitted to the inside of the valve body, reducing the annulus width to $\frac{1}{64}$ inch and thus increasing the gas velocity.

To give maximum acceleration to the valve, an electrical impulse of high current density was supplied over a short period of time, the impulse being provided by a controller of special design. Once the valve and controller were assembled a test rig was used to measure the opening time of the valve at various settings, the gas flow for various opening times and gas pressures, and to check the valve indicator mechanisms. These tests were very satisfactory and, with the valve opening for 2° crank angle, a gas flow of 400 ml per minute with a gas pressure of 400 p.s.i.a. was possible.

*Reproduced from *The Diesel Engine* by K. Hunt, published by Cassell and Co. Ltd., London.

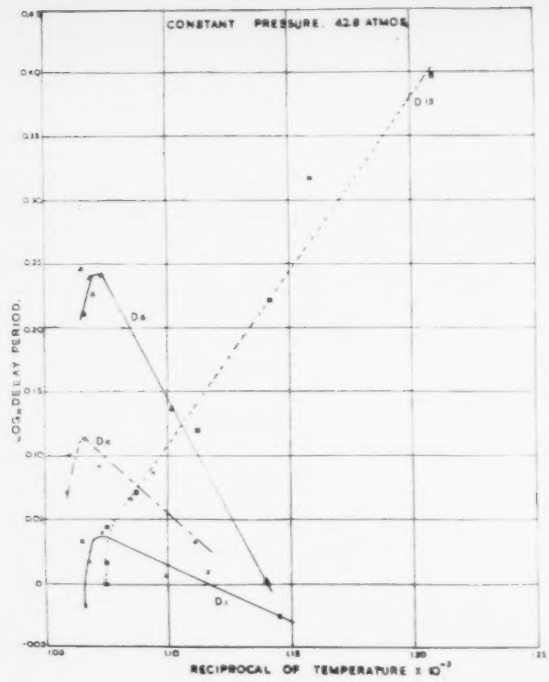


Fig. 4. Relationship between delay period and temperature for four fuels of cetane number 31 (*D*6), 53 (*D*4), 70 (*D*1) *and* 80 (*D*15).

Sampling experiments with a single fuel and with constant engine conditions were then carried out, varying the position of the valve. In the first series of experiments the valve head was flush with the surface of the chamber. In the second series the valve was pushed into the swirl chamber $\frac{1}{8}$ inch, and in a third series the mushroom-type valve was replaced by the Ricardo needle valve mounted flush with the swirl chamber wall. The object of these tests was to ascertain whether or not the position and type of valve had any effect upon the crank angle position at which peak concentrations of pre-flame intermediates occurred. The results established that the sequence of events at the wall of the chamber was the same when either valve was used, but when the mushroom valve was pushed a little way into the chamber the peak concentrations of intermediates were recorded a little earlier than at the wall. The shape of the curves obtained was the same in all experiments and the results could be reproduced in consecutive experiments. It was therefore clear that the sampling technique was in fact giving a true picture of events within the chamber and that, although smoothed somewhat by the number of cycles (1200 r.p.m.) over which the sample was drawn, the conditions in the engine were reproducible and followed a definite pattern.

With the satisfactory design of the sampling valve completed, it was now possible to investigate the variation in pre-flame intermediates with variations in fuel characteristics and engine conditions. Before doing so, however, it was desirable to obtain some further information concerning the conditions under which pre-flame reactions were favoured, in order to minimize the long, tedious, sampling programme which would have to be conducted. Earlier in the work, W. E. Malpass had made a preliminary study of the variation of length of delay period, and temperature during the delay period, with variation of injection timing for several fuels. Although the measurement of average pressure in these experiments was not entirely satisfactory, a plot of the delay period against the reciprocal of the log of absolute temperature (calculated from the average pressure) did indicate that the activation energy for the combustion reaction varied according to the nature of the fuel. A more detailed study of this variation was made by W. D. Reid, in which the delay period was measured with considerable accuracy and the pressure crank angle diagrams were established by actual pressure measurement over the operating positions. The temperature during the delay period was then calculated from the pressure values, with certain assumptions, and a plot of the relationship between delay period and temperature at constant pressure (Fig 4) obtained. It is not necessary to discuss these results in detail at this stage but they do indicate that there is a difference in the behaviour of different fuels, and suggest that the combustion of a given fuel can proceed by one of two distinct mechanisms, according to the temperature in the engine, since the graphs of log delay period versus 1/T show a distinct change of slope as the absolute temperature falls. This supports previous suggestions that a low-temperature mechanism is involved in the pre-flame reactions which changes to a high-temperature mechanism as combustion is reached.

During this investigation it was necessary to establish with certainty the crank angle position at which ignition commenced. To do this a window adaptor was fitted into the swirl chamber to feed light from the engine flame to a photo-multiplier unit connected to a cathode ray oscilloscope. This gave direct measure of the point of arrival of the flame opposite the window, thus enabling the actual duration of the delay period to be determined. The initial adaptor was modified to prevent fouling of the quartz window by carbon during the combustion (Fig 5), and subsequently used by G. H. Grigg to survey the pre-combustion period. After a number of difficulties had been overcome it was finally possible to show that in certain circumstances the pre-flame period was accompanied by flame. In general these pre-flames were obtained more readily with a low cetane fuel (cetane number 31) than with the high cetane fuel (70). They were observed with late injection (0° and −5° crank angle) and with early injection (−20° crank angle), and were accompanied by heavy knock, but were not observed when the engine was running smoothly at normal injection settings for the respective fuels. This is illustrated in Figures 6 to 10 which show the oscillograph record of the flame intensity, with the engine indicator trace as background, for the high

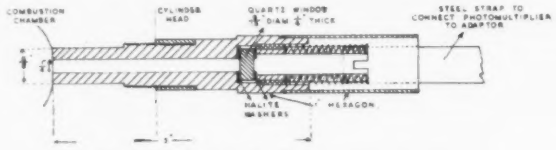


Fig. 5. Adaptor for flame measurements.

cetane fuel D.1 (cetane number 70) at injection of −5°, 0°, and −5° crank angle and for the low cetane fuel D.6 (cetane number 31) for injection at 0° and −5° crank angle. The high cetane fuel shows no pre-flame at injection of −5° and 0° crank angle but does show a small pre-flame commencing at −20° crank angle with an injection setting of −5° crank angle. The low cetane fuel shows marked pre-flames commencing between −30° and −20° crank angle for injection settings of 0° and −5°.

Having established the conditions under which intense pre-flames could be obtained, sampling experiments were conducted using the same fuels and varying the injection from −30° to −10° crank angle under the same conditions of engine speed, etc. used in the photo-multiplier studies. Under conditions which produced pre-flames the concentration of

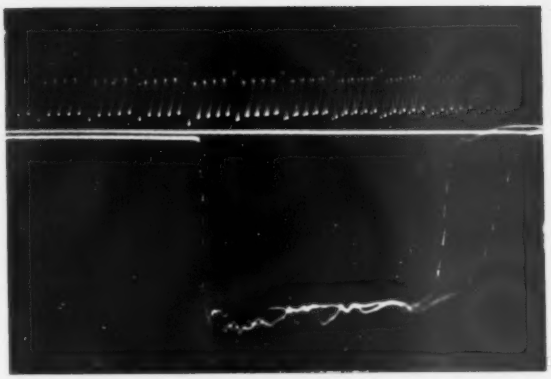


Fig. 6. Flame intensity record. Fuel D1. Injection −5°. Main flame appearance −3° crank angle. No pre-flame.

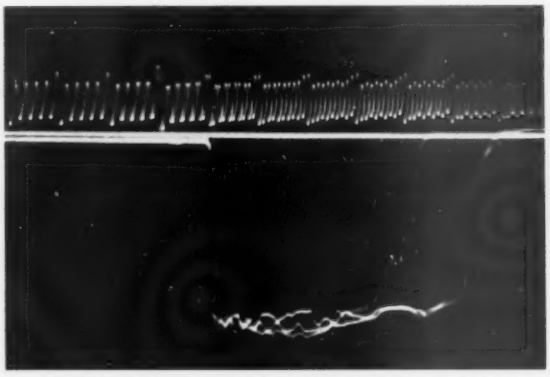


Fig. 7. Flame intensity record. Fuel D1. Injection 0° C, slight pre-flame −3°. Main flame appearance −10°.

aldehydes at the point of pre-flame was found to be a hundred times greater than the concentrations observed in the runs with the same fuel under conditions which did not produce knock. From the many sampling results obtained during the past year, two are chosen to illustrate this point. Fig 11 shows the analysis of the peroxide and aldehyde content of the swirl chamber gases with the high cetane fuel at an injection setting of −5° crank angle (compare Fig 6), and Fig 12 shows the analysis using the same fuel at injection setting of −5° crank angle (compare Fig 8). The aldehyde scale in Fig 12 is 100 times that of Fig 11, and the peak concentration of aldehydes before actual ignition is 20 parts per million with injection at −5° crank angle, and 380 parts per million with injection at −5° crank angle. The peroxide content of the gases remains low in both cases, and in fact in all cases examined so far, rarely exceeds 1·0 part per million before ignition commences.

It will be noticed that the pre-flames occur before injection of the fuel. In earlier work the presence of aldehydes in the chamber gases before fuel injection had been observed and it had been shown that these could not arise from aldehydes in the unscavenged exhaust from the previous stroke. The possibility that these aldehydes arise from oxidation of lubricating oil was disproved by the fact that the present series of experiments have shown that the pre-flames and concentration of aldehydes before fuel injection are a function of the cetane number, and hence chemical nature, of the fuel. They must be derived from unburnt fuel carried over from the previous combustion stroke, probably as liquid fuel droplets.

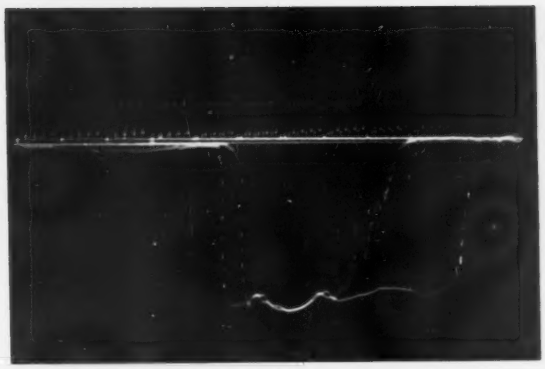


Fig. 8. Flame intensity record. Fuel D1. Injection −5°, pre-flame −20° C. Main flame appearance −17°.

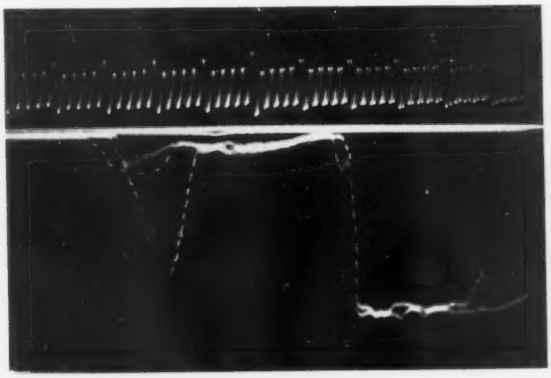


Fig. 9. Flame intensity record. Fuel D6. Injection 0° C, marked pre-flame −30° C. Main flame appearance −18°.

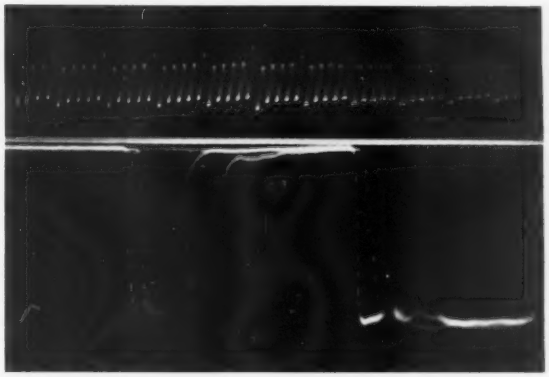


Fig. 10. Flame intensity record. Fuel D6. Injection −5°, marked pre-flame −26°. Main flame appearance −20°.

The work described is by no means complete and in the next year it is hoped to study the effect of engine variables, load, compression ratio, etc., upon the pre-flame characteristics of a variety of fuels. Details of the work to date will be published later in the Journal of the Institute of Petroleum, but the brief description given here will show the direction in which the studies are leading and will illustrate the techniques which are being employed.

From its inception some ten years ago the work has been financed by a scholarship given annually by Trinidad Leaseholds Ltd., who also generously gave the engine used in the

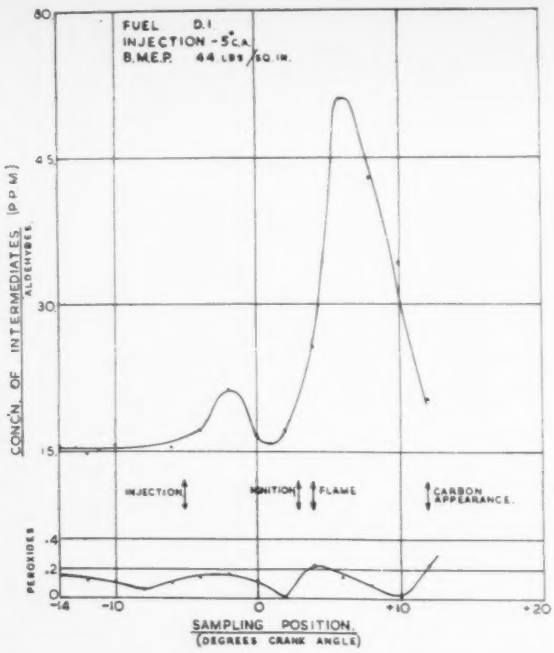
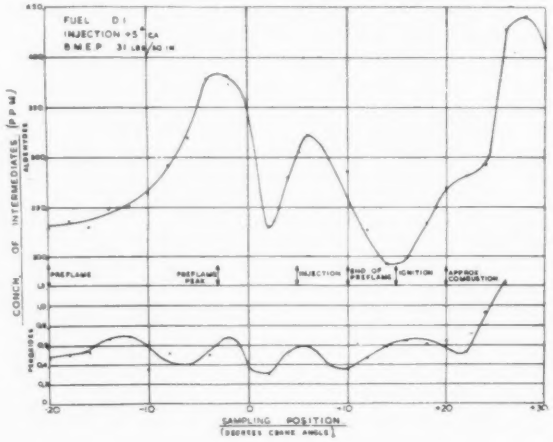


Fig. 11. *Peroxide and aldehyde content of combustion chamber gases. Fuel D*1. *Injection* −5°. (*Compare with Fig* 6.)

work. Great help has also been received from other oil companies. The British Petroleum Company has given equipment such as the Sunbury engine indicating equipment, etc., Shell Research Limited has given an engine speed controller, Esso Development Company has supplied special fuels, as has also the Fuel Research Station, B.I.C.E.R.A. loaned a photomultiplier while the University was building its own, and the Ricardo Engineering Company helped to design the electro-magnetically-operated valve. Many others have given help and advice from time to time. A research project such as this could not have been undertaken at a University without the help, financial and otherwise, which was received from the oil industry. The project was first initiated under the direction of Professor Garner and we would wish to thank the petroleum industry for the help it has given us. It is also necessary to add that the work described has been a team effort carried out by our colleagues E. P. Wright, W. E. Malpass, W. D. Reid, and G. H. Grigg.

Fig. 12. *Peroxide and aldehyde content of combustion chamber gases. Fuel D*1. *Injection* +5°. (*Compare with Fig* 8.)



★ ★ ★

Trade Literature, etc.

Fire Protection

Leaflets are available from William Kenyon and Sons Ltd. and Meta Mica Ltd., Dukinfield, Cheshire, which give details of these companies' fire-prevention and thermal insulation products. These include "Asbestospray"—a fibre insulation which is sprayed on to surfaces for condensation control and sound proofing as well as for insulation and fire-prevention purposes, Meta Mica ceiling panels, and fibre cladding for steel structures.

New Flame Photometer

A flame photometer and an infra-red spectrometer were among the new instruments exhibited recently by Unicam Instruments Ltd. of Cambridge.

"Colclad" Steels

An illustrated booklet published by Colvilles Ltd. of Glasgow gives details of the manufacture and applications of Colclad, stainless-clad, nickel-clad, and monel-clad steels.

New Liquid Air Machine

A new gas refrigerating machine which can be used to produce liquid air is now being made by Philips Electrical Ltd. following developments carried out in the Philips research laboratories.

With the new plant, temperatures of −200°C can be obtained quickly and five litres of liquid air per hour can be produced at an ambient temperature of 20°C.

The installation consists of a liquefier with built-in air drier, carbon-dioxide remover, and de-froster on a common bed-plate with a 10-h.p. squirrel cage motor.

Analytical Instruments

At the recent exhibition held in London by the Physical Society interesting new exhibits were shown by Mervyn Instruments. These included the "Square-Wave Polarograph", an instrument which extends the use of polarography for rapid chemical analysis by applying square wave voltage to the cell; a spectrometer amplifier; and a new model infra-red spectrometer.

Brightray "H"

A new grade of nickel-chromium alloy for high-temperature furnace resistors has been produced by Henry Wiggin and Company Ltd. The alloy is a modified 80 : 20 nickel–chromium alloy for use as a heating element in electric resistance furnaces where the element operating temperature exceeds that for which Brightray "S" is normally suitable. The new grade is intended for elements operating at temperatures of 1100° to 1250°C, and is available in the form of rod, wire, and strip.

"Susgra"

Colloidal Graphite Ltd. has recently expanded the capacity of its plant for the production of "Susgra" colloidal graphite dispersions.

Notes of the Month

Journalists to Compete for Prizes in Congress Competition

Prizes to the value of 1,300,000 lire are to be awarded by the General Organizing Committee of the Fourth World Petroleum Congress for the best articles in daily newspapers and periodicals on a special Congress subject.

The competition is open to both Italian and foreign journalists and the subject is "the contribution already made and at present being made to progress by petroleum and hydrocarbons in general, and the important position attained in recent years in the economy of Italy by the petroleum and hydrocarbon industries in the general system of the sources of energy".

New U.S. Refinery

A new 35,000-b.d. refinery is to be built on a 1,200-acre site near Yorktown, Virginia, by the American Oil Company. It is scheduled for completion in 1956 and will be the first gasoline manufacturing plant to be built in the State of Virginia.

Chief products of the new refinery will be an "unleaded" premium gasoline, gasoline, kerosine, and fuel oils. These will be marketed in the District of Columbia and in eighteen Eastern States from Maine to Florida. The Company also has a 145,000-b.d. refinery in Texas City and asphalt refineries at Baltimore and Savannah.

The M.W. Kellogg Corporation has been given an initial general construction contract for two major refining process units, three buildings, and all electrical and pipeline facilities for the refinery. Work has already begun by the Tidewater Construction Company on the dredging of York River and the construction of pier facilities near the refinery site. The piers will be constructed to accommodate simultaneously one super-tanker, 750-feet long, one T-2 tanker of 550 feet, and two barges from 150 to 250 feet in length.

New Self-mixing Oil

Mobilmix TT—a new self-mixing oil—has been prepared by the Vacuum Oil Co. Ltd. for the lubrication of two-stroke engines. The new oil mixes very readily with petrol and contains special anti-oxidant and detergent additives to reduce bearing corrosion, piston ring sticking, and exhaust port deposits.

Research at Birmingham

The Joint Standing Committee for Research of the University of Birmingham reports that during the 1953-54 academic year, the Department of Chemical Engineering continued, among other researches, its work on the behaviour of a bubble cap plate. The relation between pressure drop and efficiency is being elucidated and efficiency data for a grid tray at various flow rates and settings have been obtained.

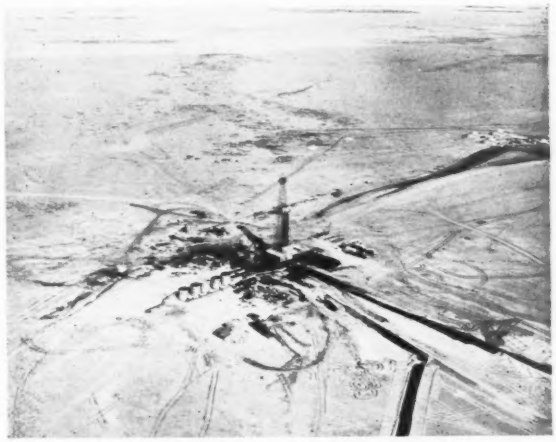
Operating characteristics of Stedman packing have been investigated at reduced pressure and the unit has been used to fractionate middle distillates from Kuwait, Venezuela, and Oklahoma crudes. Analysis of these fractions has shown interesting relationships between hydrocarbon constitution and biological activity and further tests are in progress in the Pathological Department of the Medical School.

In the combustion field, the study of the effect of di-*iso*butylene upon the oxidation of *n*-heptane has continued and the results compared with the effect of octane-1. The oxidation of benzene and *n*-heptane has been studied. Samples taken from a diesel at any predetermined stroke position have been analysed to show the pressure of chemical intermediates and their relationship to cool flame formation.

Egyptian Trade Unionists at Stanlow

Four Egyptian trade unionists, guests of H.M. Government, paid a visit to the Shell refinery at Stanlow recently. The members of the party represented the textile, oil, transport, and cement industries of Egypt and they were accompanied by officials from the British Foreign Office and the Ministry of Labour and National Service.

In addition to seeing the main units, the party visited the medical centre, canteens, and social amenities at Stanlow and found these of particular interest. A visit was also made to the new Queen Elizabeth II dock at Eastham—discharge terminal for crude oil cargoes for Stanlow.



Raudhatain in North Kuwait where the Kuwait Oil Company is carrying out deep test drilling operations. The rig pictured here was skidded 99 miles across the desert to its position.

"Silver City" is the name given to the Raudhatain scene of operations. These prefabricated buildings were hauled across the desert to form a camp for drilling personnel.

Shell Haven Fire Awards

The courageous action of staff at the Shell Haven refinery during the recent explosion and fire was recognized at a presentation ceremony when Sir Francis Hopwood, a managing director of The Royal Dutch Shell Group of oil companies gave gold watches recording the event and cheques to each of the three men chiefly concerned.

A Shell photo

Left to right: Sir Francis Hopwood, R. A. Jackson, T. Brookbank, and H. Dobson.

The recipients were T. Brookbank, refinery engineer; H. Dobson, refinery superintendent, and R. A. Jackson, of the laboratory staff. It was Mr Brookbank who entered the danger area after the outbreak of fire to close a valve and so prevent petrol from feeding the flames and causing further explosions. Mr Brookbank made four attempts before he succeeded in closing the valve and was sprayed with water by Mr Dobson and Mr Jackson during his attempts.

Multi-purpose Tractor Oils

Advances in the compounding of lubricating oils, from which the motorist has recently benefited, are now to be made available to the farmer in the form of two new tractor engine oils, Shell Tractor Oil Universal and BP Energol Tractor Oil Universal.

The oils have been produced by the Shell and British Petroleum Groups respectively and are marketed by Shell-Mex and B.P. Each oil has a similar application but they are different, independently-produced oils.

They are designed to allow correct lubrication of diesel, vaporizing oil, and petrol tractor engines with a single oil, and they are suitable for use all the year round.

Simplicity, double life of the oil in vaporizing oil tractors, easier starting, instantaneous lubrication, and engine cleanliness are the advantages claimed for the two new oils, in addition to the lessening of storage problems.

The oils will be marketed in returnable 40-gallon barrels at 8*s*. 6*d*. per gallon, and in non-returnable 5-gallon drums at 9*s*. 8*d*. per gallon.

Distillation Column towed to Site

Transportation of a large steel distillation column from London to Grangemouth for erection at the works of Forth Chemicals Ltd. presented a problem to the manufacturers—G. A. Harvey and Co. (London) Ltd. The solution was to despatch the column, made watertight, by sea—a tug towing it through the North Sea and up the Firth of Forth.

Launching was carried out by hauling the column on bogies to a slipway a short distance from the workshops and floating it off on the tide.

The column, which weighs 85 tons and measures 140 ft in length, is one item in the expansion programme of Forth Chemicals Ltd.—formed in 1950 by British Petroleum Chemicals Ltd. and Monsanto Chemicals Ltd. Forth Chemicals plans to double its output of monomeric styrene for the plastics industry.

* * *

SITUATIONS VACANT

Managerial Personnel needed for Research Centre in the Petroleum Industry

Ente Nazionale Idrocarburi (E.N.I.) has under its supervision a number of Italian Companies active in the field of petroleum and petrochemicals. ENI's major activity is centred in the following items:

- gas and oil field exploration and exploitation (current production: 10^5 billion cu. ft. of natural gas per year);
- operator of a 2 00-mile pipeline system (capacity over 700 million cu. ft. per day);
- owner and operator of a tanker fleet of around 120,000 dwt;
- owner and operator of an extensive network for distribution of petroleum products and LP gas throughout Italy (64 bulk plants, 4000 stations, etc.);
- control over or shareholding in refineries having a processing capacity of about 6 million tons of crude oil per year;
- owner of factories (1500 employees) for construction of machinery;
- shareholding of chemical plants (700 employees) for production of synthetic dyes, detergents, etc.;
- under construction, a petrochemical plant (production capacity—30,000 tons per year of synthetic rubber and 350,000 tons per year of ammonium nitrate).

E.N.I. is organizing a big research centre for investigation and development of petroleum processing and manufacture of petrochemicals. Some departments are expected to begin operation next summer.

Italian or foreign technical experts, with a wide educational background, specific training, organizational and managerial ability, are required to fill positions as heads of the main departments of the laboratories.

Specifically, the following are sought:

(1) **Chemist** or **physicist** with specific knowledge and experience in thermodynamic and chemico-physical problems;
(2) **Chemist** specialized in the preparation of organic compounds, particularly those derived from hydrocarbons;
(3) **Inorganic chemist** soundly and completely acquainted with modern methods of experimentation, research, and testing;
(4) **Engineer or industrial chemist** specially trained in the methods for improving petroleum products applications;
(5) **Engineer or physicist,** with physico-technical and technological training, specialized in the problems of thermotechnics, measurements, and controls;
(6) **Engineer or industrial chemist** with extensive research experience in the field of crude oils processing;
(7) **Engineer or industrial chemist** particularly experienced in extending laboratory procedures to pilot plants;
(8) **Engineer** with good theoretical knowledge and laboratory experience in engine tests on fuels and lubricating oils;
(9) **Engineer or industrial chemist** specially trained both in theory and practice in the fields of corrosion and protective means for materials

Note.—University degree mandatory.

Applications should state age and other usual personal data, educational background and qualifications, practical experience, etc., and should include a photograph. Please address personally to the: **Presidente dell'Ente Nazionale Idrocarburi, Via Lombardia, 43-Roma-Italy,** with the special note **RISERVATA PERSONALE** (*i.e.*, to be opened by addressee only).

Absolute discretion in every respect is assured.

Salary offered will be in accordance with position, training, and qualities required.

IN THE SERVICE OF YOUR INDUSTRY

. . . with a range of products including . . .

Santolube 398, 394Z (motor oil inhibitors for Service ML/MM). **Santolube 204, 205A, 379** (detergent inhibitor combinations for Service MM/MS). **Santolube 208, 210, 382, 388** (detergent inhibitor combinations for Service MM/MS/DG). **SP 780, SP 784** (detergent inhibitor combinations for Service MM/MS/DG/DS). **Santopour BX** (pour point depressant). **Santolube AR & 75** (rust inhibitors for turbine oils). **Santolene F** (sludge inhibitor for fuel oils).

SANTOLUBE and SANTOPOUR are Registered Trade Marks.

Write for full details to Monsanto Chemicals Limited, 159 Victoria Station House, Victoria Street, London, S.W.1 and at Royal Exchange, Manchester, 2.

MONSANTO

Regd.

MONSANTO CHEMICALS LIMITED

Victoria Station House, Victoria Street, London, S.W.1

fly **BEA** *to Rome*
in 3½ hours

BEA looks forward to the pleasure of flying delegates to Rome for the Fourth World Petroleum Congress in June.

VISCOUNT

ELIZABETHAN

BEA summer services include *daily* flights from London to Rome, by Europe's finest pressurized airliners. By the famous 4-engined turbo-prop VISCOUNT, which is in a class of its own over the longer non-stop routes; flying time 3½ hours. Or by high-wing ELIZABETHAN, with landscape windows and spacious, lounge-like cabin — unrivalled for sheer comfort and smoothness in the air.

Details, timetables, and reservations from principal Travel Agents; or from BEA, Dorland Hall, 14-20 Regent Street, London, S.W.1. Telephone: Gerrard 9833.

fly **BEA** IN EUROPE'S FINEST AIR FLEET

BRITISH EUROPEAN AIRWAYS

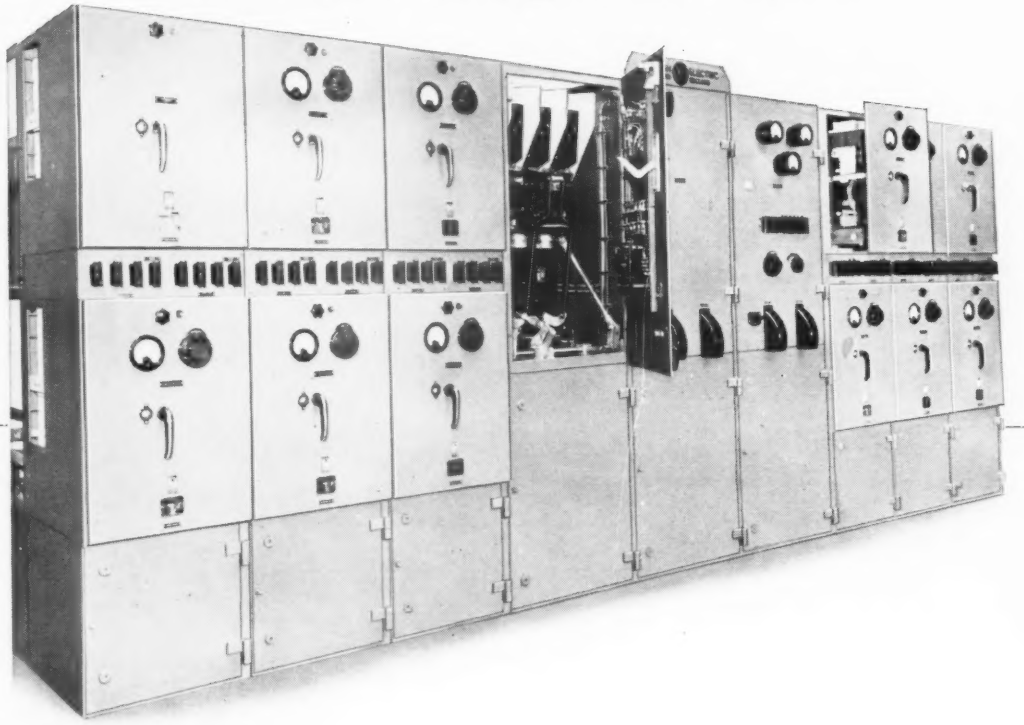
ADVERTISERS

	PAGE
Anchor Chemical Co. Ltd	May
Audley Engineering Co. Ltd	May
E. B. Badger & Sons Ltd *Inside back cover*	
Baird & Tatlock (London) Ltd	xx
E. W. Bliss (England) Ltd	liv
Blundell & Crompton Ltd	xlviii
British European Airways	xxxii
British Petroleum Co. Ltd	xxxviii
British Thomson-Houston Co. Ltd.	May
W. J. Brooker Ltd	Apr.
W. P. Butterfield Ltd	xlix
Cape Asbestos Co. Ltd, The	xxxix
Causeway Reinforcement Ltd	xxiv
Consolidated Pneumatic Tool Co. Ltd	xvi
Thos. Cook & Son Ltd	Mar.
A. F. Craig & Co. Ltd	iv & v
D. & C. and William Press Ltd	xix
Deutsche Schachtbau-und Tiefbohr-gesellschaft m.b.H.	l
Dominion Rubber Co. Ltd	xxvi
Elliott Bros (London) Ltd	Mar.
English Electric Co. Ltd	xxxiii
Esso Petroleum Co. Ltd	iii
Evershed & Vignoles Ltd	Feb.
Failing Supply Co. Ltd.	xii
George E. Failing Co.	xiii
S. W. Farmer & Sons Ltd	vi
Fibreglass Ltd	lviii
Fisher Governor Co. Ltd	i
Foamite Ltd	xi
Ford Motor Co. Ltd	vii
Foxboro-Yoxall Ltd	xxxv

	PAGE
W. J. Fraser & Co. Ltd	xxx
M. Fürst	vi
A. Gallenkamp & Co. Ltd	xviii
General Electric Co. Ltd	xxvii
General Refractories Ltd	xxviii
Geophysical Service Inc.	xli
Matthew Hall & Co. Ltd *Inside front cover*	
Joshua Hindle & Sons Ltd	—
Honeywell-Brown Ltd	xxiii
Houdry Process Corpn	xlv
Hydronyl Syndicate Ltd, The	li
Jerguson Tress Gage & Valve Co. Ltd	—
Johnson & Phillips Ltd	May
Kellogg International Corporation	ii
Wm Kenyon & Sons Ltd	lv
Lake & Elliott Ltd	l
LeGrand, Sutcliff & Gell Ltd	liii
Lincoln Electric Co. Ltd	xviii
Liquids Control Ltd	Mar.
London & Thames Haven Oil Wharves Ltd	xxv
M & C Switchgear Ltd	May
A. & J. Main & Co. Ltd	viii
Martin & Lunel	xxiv
Metal Containers Ltd *Back cover*	
Metropolitan-Vickers Electrical Co. Ltd	Apr.
Monsanto Chemicals Ltd	xxxi
Moon Brothers Ltd	xxxiv
National Benzole Co. Ltd	May
National Fire Protection Co. Ltd	xliv

	PAGE
Newman, Hender & Co. Ltd	xxi
Pierson & Co. Ltd	—
Perrault Equipment Co.	xiv
Petroleum Inventions Ltd	May
Piggott Brothers & Co. Ltd	viii
Power-Gas Corporation Ltd, The	xvii
W. Press & Son Ltd	xxix
Procon (Great Britain) Ltd	lvii
Pye Telecommunications Ltd	xxii
Pyrene Co. Ltd., The	lii
John Rabone & Sons Ltd	May
Reed Roller Bit Company	lvi
Regent Oil Co. Ltd	Apr.
Rubery, Owen & Co. Ltd	Apr.
Sankey-Sheldon Ltd	Apr.
Serck Tubes Ltd	xxxvii
Shell-Mex & B.P. Ltd	xlvi
Shell Petroleum Co. Ltd	xlii
Simmons & Hawker Ltd	xlvii
Société des Huiles de Cavel & Roegiers	lx
Solus-Schall Ltd	xxxvi
South Durham Steel & Iron Co. Ltd	Mar.
Peter Spence & Sons Ltd	xliii
Stewarts and Lloyds Ltd	lxix
Stothert & Pitt Ltd	May
United Steel Companies Ltd, The	ix
Vacuum Oil Co. Ltd	xxxvi
W-K-M International Corp	xv
C. C. Wakefield & Co. Ltd	xxxiv
George Wimpey & Co. Ltd.	xl
Woodfield Hoist & Associated Industries Ltd	x

Air circuit breakers for medium voltage distribution



The 415 volt 15 MVA single double tier switchboard illustrated is one of several supplied to the various pumping stations of the Iraq Petroleum Co. Ltd. It incorporates types OB2 and OB3 air circuit breakers, each with double isolation.

The type OB2 circuit breaker is available in current ratings of 600 amps and below, whereas the type OB3 circuit breaker has a maximum current rating of 1600 amps and breaking capacity of 30 MVA.

'ENGLISH ELECTRIC'

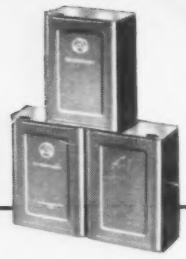
switchgear

THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE, KINGSWAY, LONDON, W.C.2

Switchgear Department, Liverpool

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

SGL 14

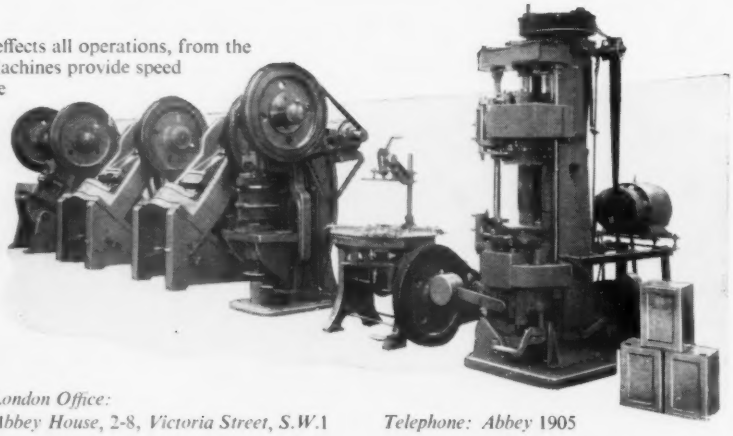


4 GALLON (IMP) OR FIVE GALLON (USA) SQUARE PETROL TINS

COMPLETE PLANT

for High-Speed Continuous Production

The battery of machines illustrated below effects all operations, from the sheet to the finished petrol tin. MOON Machines provide speed of output and quality of finish and embrace all operations in metal box or drum manufacture.
We shall be pleased to apply our experience to your problems.
Reasonable deliveries can now be given.
Write for full details of any type of machine in which you are interested.



MOON
Regd. Trade Mark

London Office:
Abbey House, 2-8, Victoria Street, S.W.1 *Telephone: Abbey 1905*

MOON BROTHERS LIMITED · BIRKENHEAD *Telephone: Birkenhead 1527 (3 lines)*

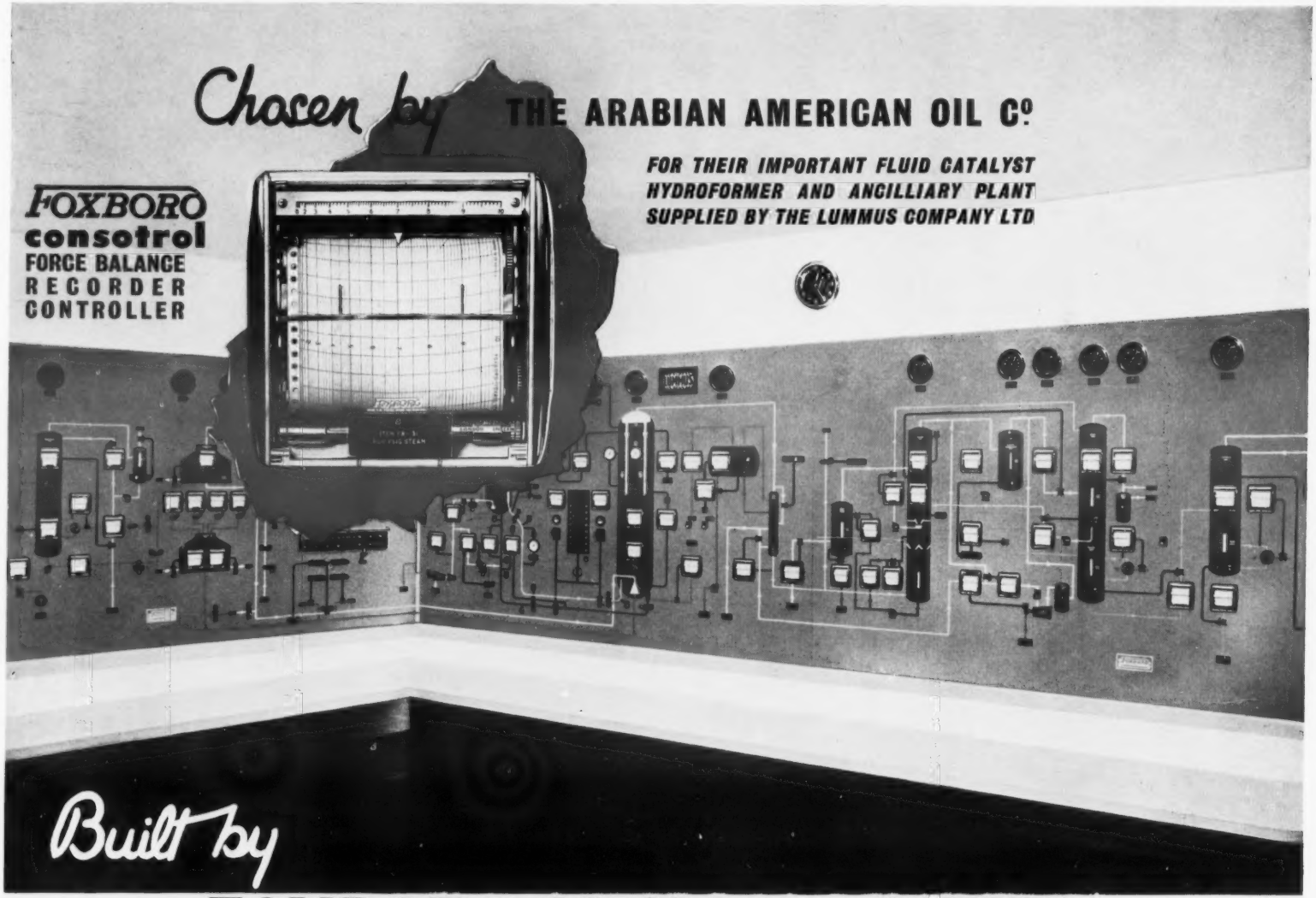
MAKERS OF TIN BOX AND DRUM MAKING MACHINERY

dm MB.74

EVERY British car maker approves

WAKEFIELD
Castrol
MOTOR OIL
(PATENTED)

THE MASTERPIECE IN OILS



FOXBORO-YOXALL LIMITED

LOMBARD ROAD · MERTON · LONDON · S.W.19

NON-DESTRUCTIVE TESTING

X-RADIOGRAPHY
OF HORTON SPHERE

We have examined
Oil Pipelines
and
Refinery Installations
for the leading Oil Companies and Contractors
in Europe, Asia and Australia.
May we also help
YOU

SOLUS-SCHALL LIMITED
18-22 NEW CAVENDISH STREET, LONDON W.1
X-RAY · GAMMA RAY · ULTRASONIC · MAGNETIC

Europe's Finest Grease Plant

It is now almost a year since Vacuum Oil Company brought into service at Birkenhead the most modern grease-making plant in Europe. The new plant has been planned and built entirely since the war. It embodies every modern development in grease-making techniques that can contribute in any way to the quality of the lubricants it is producing for industry, for the railways, for ships large and small, and for all kinds of road vehicles. This fine new plant is a further demonstration of Vacuum's leadership in the provision of correct lubrication for machinery of every kind.

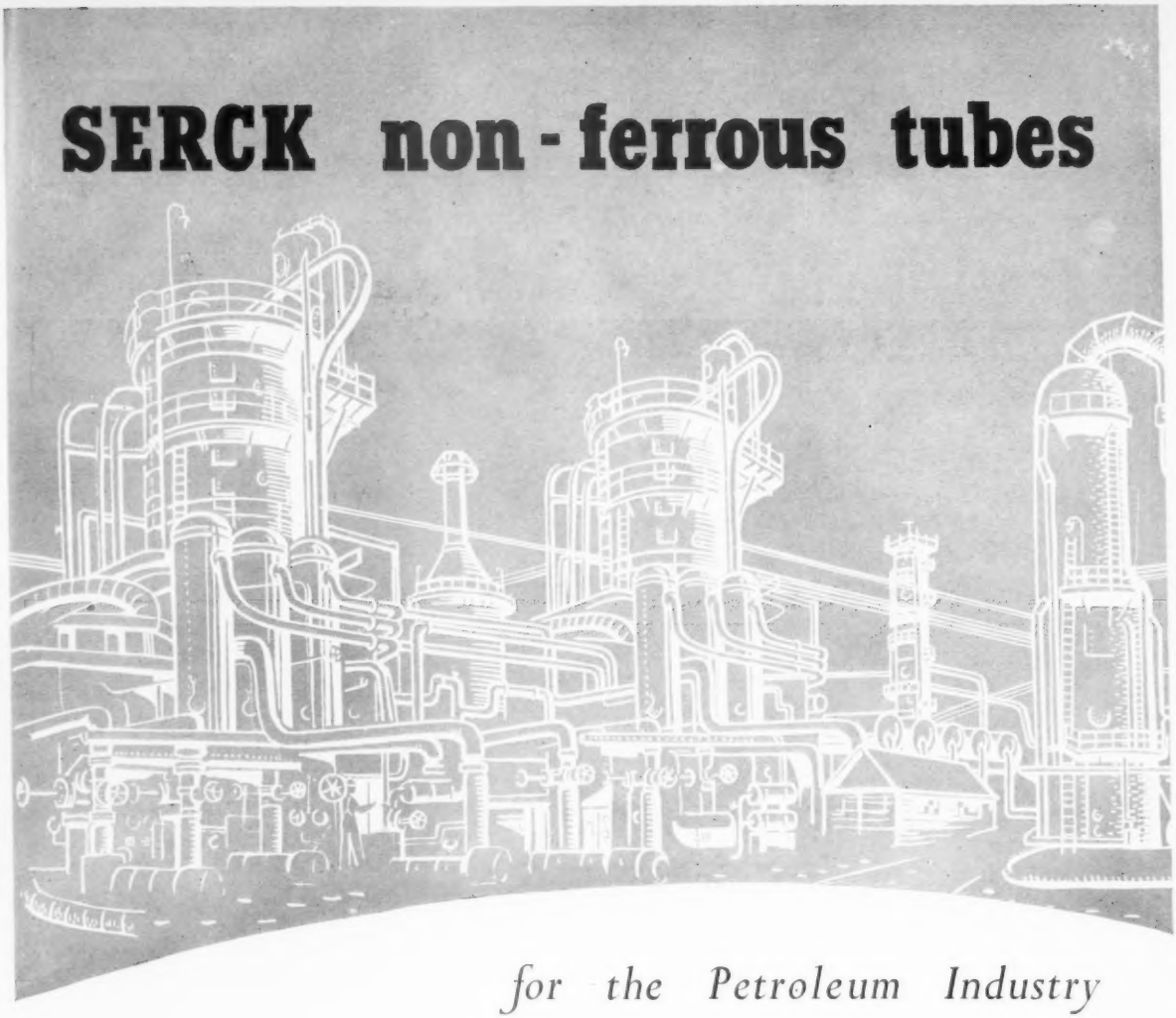
A complete lubrication service for everything mechanical

VACUUM OIL COMPANY LIMITED

VACUUM

Makers of MOBILOIL · MOBILGAS · MOBILAND · GARGOYLE LUBRICANTS · DELVAC AND SOVAC OILS · VACUUM FUEL OILS

SERCK non-ferrous tubes



for the Petroleum Industry

With the expansion of foundry facilities by the installation of the latest induction melting plant, the development of a specialised vertical extrusion process and the recent completion of a new tube mill—one of the largest and most up-to-date of its kind in this country today—Serck are able to offer a greatly increased tonnage of non-ferrous tubes.

The range of tubes includes 70/30, Admiralty brass, Aluminium bronze, aluminium brass and cupro-nickel made to British, American or other accepted specifications. The alloys are compounded to give the highest resistance to corrosion and eliminate de-zincification. Also every tube is individually tested hydraulically to 1,000 lb sq. in. or higher pressures as specified.

Stringent laboratory tests, rigid supervision throughout all stages of manufacture, and heat treatment in a controlled atmosphere ensure that Serck tubes will give long, trouble-free service.

Serck technical advisory service is always ready to help you select the tube best suited to your requirements.

SERCK TUBES LIMITED . BIRMINGHAM 11

BP SHIPS THE OIL

The British Tanker Company, shipping subsidiary of The British Petroleum Company Limited, operates one of the world's largest tanker fleets, shipping crude oil and products to refineries and markets in many countries.

There are fourteen BP refineries in Great Britain, Aden, Australia, France, Belgium, Italy, Germany and Israel. The latest, at Kwinana in Western Australia, came on stream in February, 1955, more than three months ahead of schedule.

The British Petroleum Company distributes and markets oil products both direct and through various associated companies.

Its prospecting subsidiary, the D'Arcy Exploration Company, is interested in oil-bearing territories in many parts of the world.

The Company's main research establishments are at Sunbury in Middlesex and at Kirklington in Nottinghamshire.

The BP Shield is the symbol of the world-wide organisation of

The British Petroleum Company Limited

CAPOSITE-insulated pipe-lines at the British Petroleum Co's Kent Oil Refinery.

We've a long FIBRED start!

As compared with other forms of asbestos insulation, CAPOSITE enjoys one very considerable advantage. This is in the matter of fibre-length — a key factor in the thermal efficiency of all asbestos materials. CAPOSITE is made from the uniquely long-fibred type of asbestos known as *Amosite*, obtained from The Cape Asbestos Co's own mines. This extra length of fibre gives it a long start, both in thermal efficiency and in other important respects as well ; in greater durability, for example, without any corresponding excess of weight. CAPOSITE is available in moulded form to suit the contour of the surface to be insulated. It is easily applied, combining lightness in weight with exceptional strength and durability. CAPOSITE Insulations are designed for use up to 1,000 F. For temperatures in excess of 1,000 F there is a complete range of CAPOSIL High Temperature Insulations.

CAPE

CAPOSITE

The Cape Asbestos Company Limited, 114-116 Park Street, London, W.1. Tel : GROsvenor 6022

TA6752

WIMPEY

BUILDING, CIVIL, ELECTRICAL AND MECHANICAL ENGINEERING CONTRACTORS

GEORGE WIMPEY & Co., LIMITED have successfully carried out every aspect of work connected with oilfield development, refineries and oil port installation at home and overseas.

Contractors to:

- ANGLO-SAXON PETROLEUM COMPANY
- ASSOCIATED ETHYL COMPANY
- BRITISH MALAYAN PETROLEUM COMPANY
- BRITISH PETROLEUM COMPANY
- ESSO PETROLEUM COMPANY
- IRAQ PETROLEUM COMPANY
- KUWAIT OIL COMPANY
- SARAWAK OILFIELDS COMPANY
- STANDARD VACUUM OIL COMPANY

Overseas at :

Aden
Australia
Borneo
Canada
Cyprus
Gold Coast
Iraq
Kuwait
Malaya
Pakistan
Sierra Leone
Singapore
South Africa
Sudan
Sumatra
Turkey

GEORGE WIMPEY & CO. LIMITED

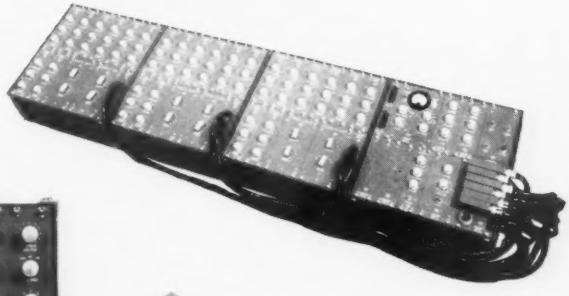
HAMMERSMITH GROVE LONDON, W.6

GSI INSTRUMENTATION

covers the Seismic Spectrum

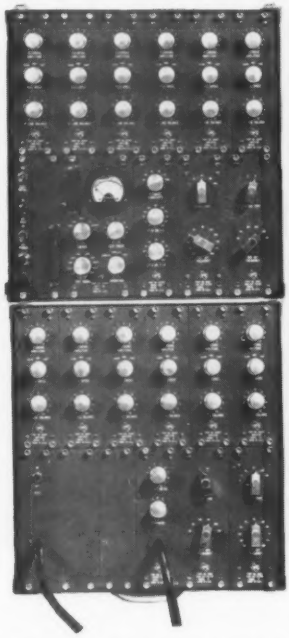
The VLF (very low frequency) Refraction System

FREQUENCY RESPONSE 2-50 CPS



The HR Shallow Reflection System

FREQUENCY RESPONSE 30-500 CPS



The 7000 Series Amplifier System

FREQUENCY RESPONSE 10-200 CPS

GSI EXPERIENCE

covers a Quarter-Century

1930 ☆ 1955 GSI 25TH ANNIVERSARY

Until recently geophysical work has been limited largely to the 18 to 70 cps frequency range. Now GSI can provide useful data in the range of 2 to 500 cps. Call GSI for service tailored to your seismic needs. ***Write for bulletins on the systems pictured.***

GEOPHYSICAL SERVICE INC.

5900 LEMMON AVENUE • DALLAS 9, TEXAS

Oil means people

The Shell companies, in their operations across the world, pay the wages of about 250,000 people. Good wages for good work. People who make their careers with Shell seldom look over their shoulders for better prospects or better treatment in other jobs.

The Shell family is of all races, creeds and colours. Of the 250,000 on the payrolls, more than 240,000 are nationals of the countries in which they work. Oil pioneering has often done much to improve and steady the economy of a country by providing revenue for its treasury, and employment, wages and buying power for its workers.

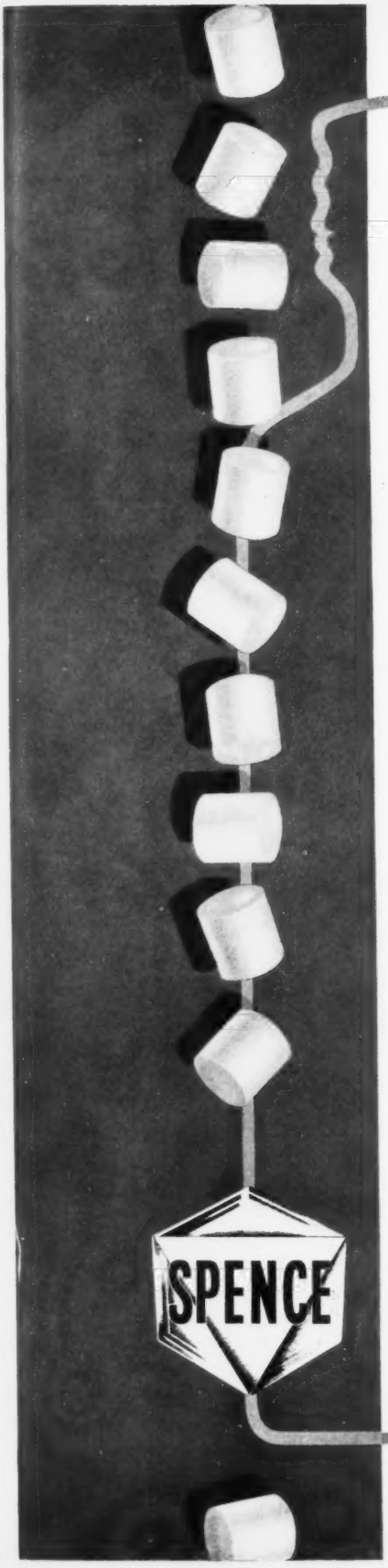
Finding, producing or refining oil in a hitherto uninhabited region can involve the creation of whole new communities with schools, churches, hospitals, health services, roads .... and a real sense of civic pride. These social services may add greatly to operating costs, but that is welfare.

For every man or woman who works with Shell, another 1,000 depend on Shell to make the wheels of their world go round. The products of Shell Research equip your garage (oil and petrol), your garden (insecticides and weed killers), your kitchen (detergents and kerosine) and your dressing table (cosmetics and medicines).

Shell employ people by the tens of thousands. They serve people by the hundred millions.

people matter to SHELL

THE SHELL PETROLEUM CO. LTD., ST. HELEN'S COURT, LONDON, E.C.3



ACTIVE ALUMINA

AND CATALYSTS FOR INDUSTRY . . .

Spence type A active alumina is a powerful dehydration catalyst and is also an excellent activating carrier for a wide range of mixed catalysts.

Spence catalysts are hard, porous and active, and can be prepared, in either pellet or granular forms, to the customer's individual research or production requirements.

CHEMICALS FOR INDUSTRY

PETER SPENCE & SONS LTD., WIDNES, LANCS. ALSO AT LONDON & BRISTOL

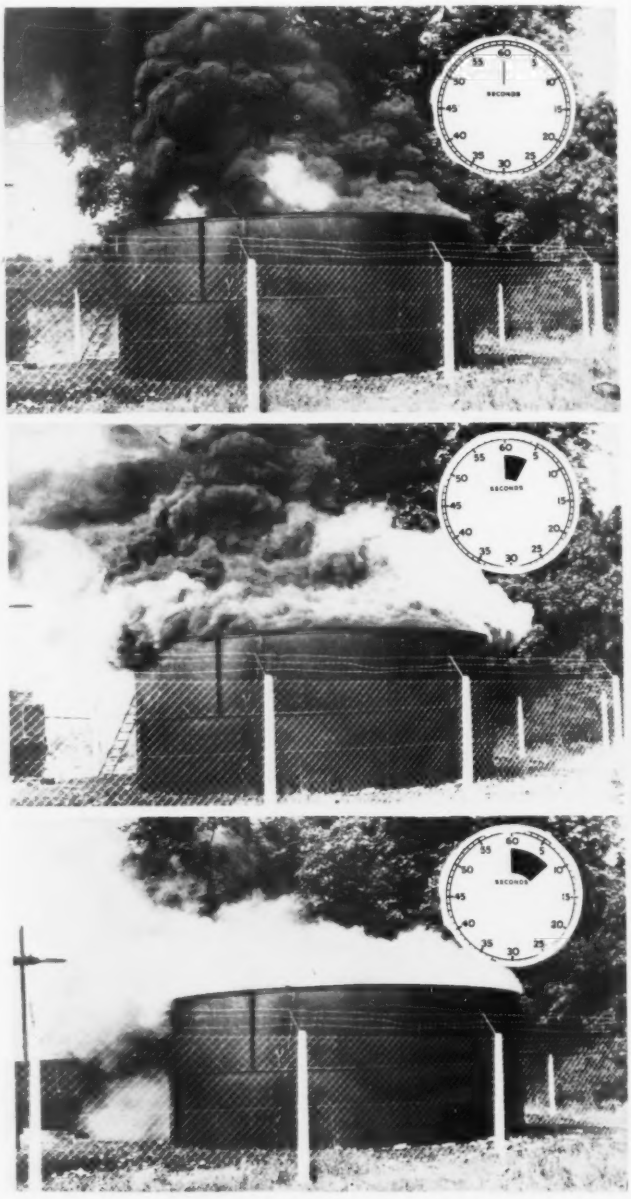
5063

Immediate! Automatic!

OIL & PETROL FIRES

EXTINGUISHED

IN TEN SECONDS!



The National Fire Protection Co., who pioneered 25 years ago in the use of Methyl Bromide as a fire fighting medium, announce the introduction of a new and revolutionary type of equipment for the protection of Oil and Petrol Storage Tanks.

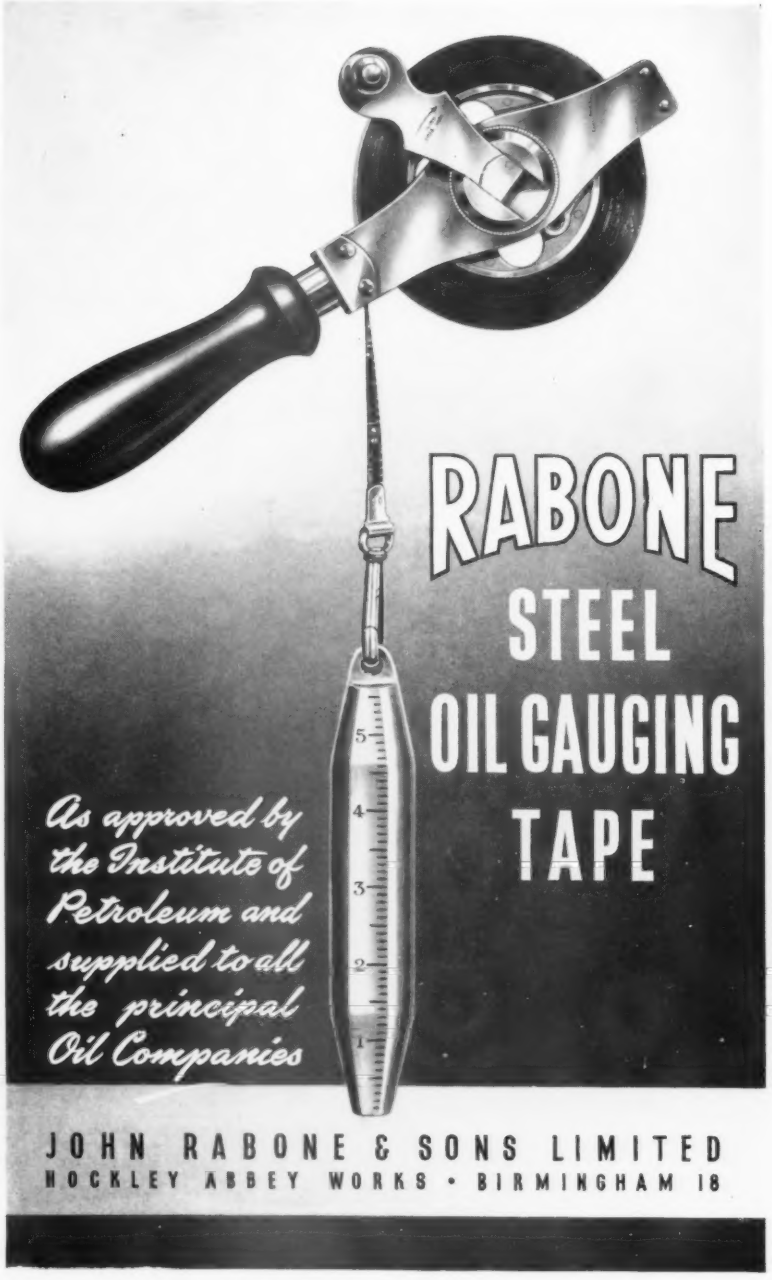
It is ingenious, simple, scientific—so designed that flame or rise of temperature at once brings it into action and leads to extinction of the fire. Can be fitted to existing tanks without any major alteration. Illustrated is the extinction within ten seconds of a fire in an oil storage tank, 25 ft. in diameter by 10 ft. in height, of 33,000 gallons capacity.

This equipment is now generally available. Inquiries are invited.

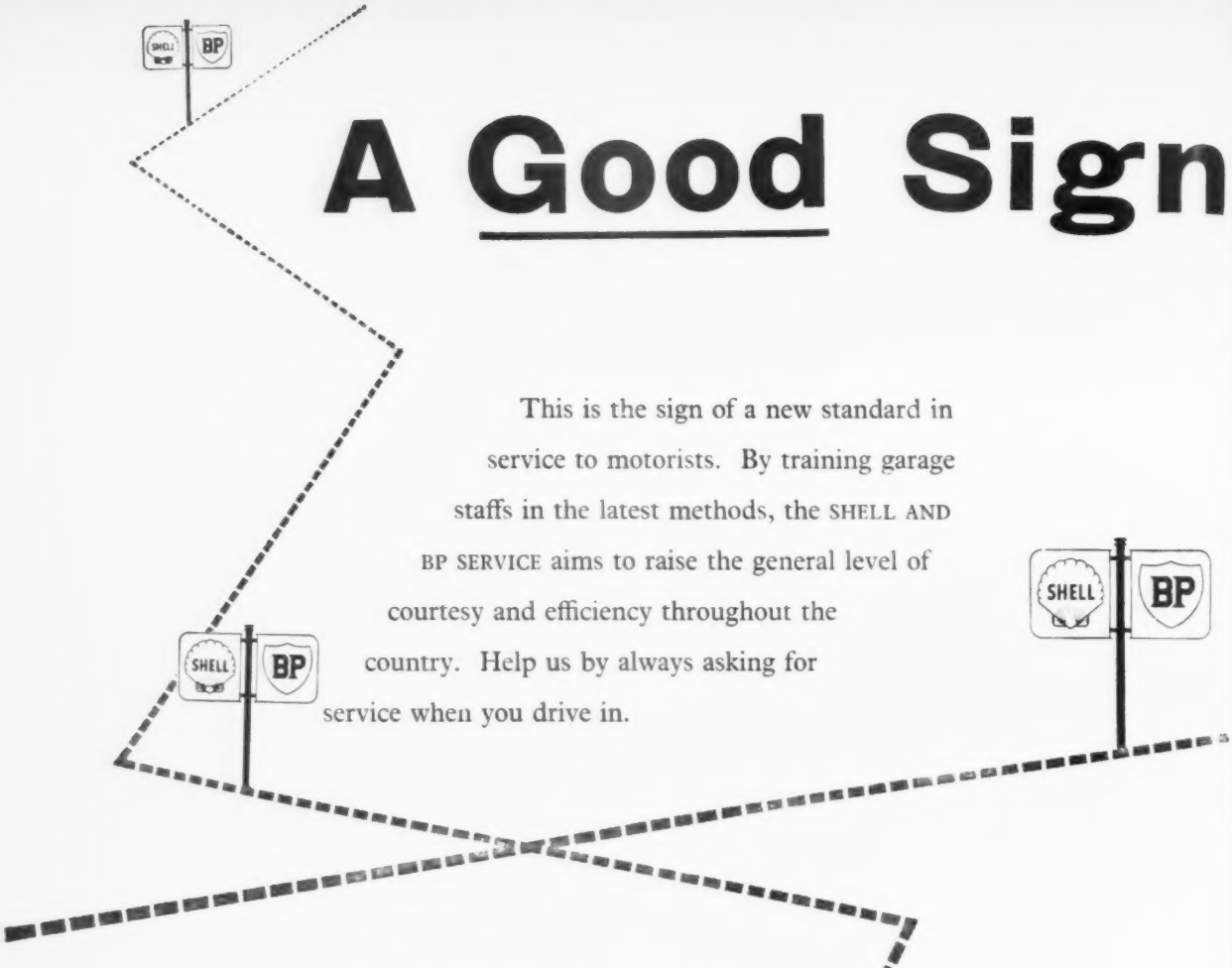
THE NATIONAL FIRE PROTECTION CO. LTD.

Essex Works Faggs Road Feltham England

Telephone: FELtham 4081



JOHN RABONE & SONS LIMITED
HOCKLEY ABBEY WORKS • BIRMINGHAM 18



A Good Sign

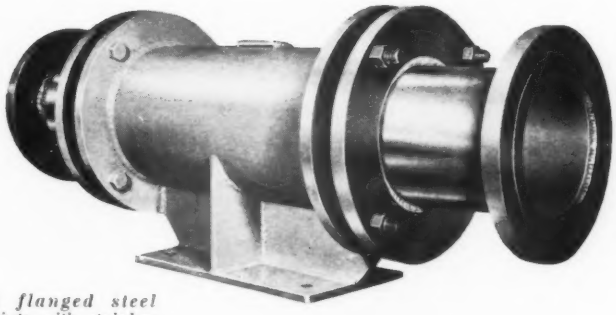
This is the sign of a new standard in service to motorists. By training garage staffs in the latest methods, the SHELL AND BP SERVICE aims to raise the general level of courtesy and efficiency throughout the country. Help us by always asking for service when you drive in.

It identifies the products which are marketed by Shell-Mex and B.P. Ltd. in England, Wales and Northern Ireland, by Scottish Oils & Shell-Mex Ltd. in Scotland and by Irish Shell Ltd. in the Republic of Ireland. Behind all these companies lie the vast resources of the Shell, BP and Eagle Groups.

S&H ENGINEERING *for the* OIL INDUSTRY

Heat Exchangers

Filters and Separators



4"—14" bore flanged steel Expansion Joints with stainless steel-clad sliding surfaces: as supplied to The Lummus Company, Ltd. for THE VACUUM OIL COMPANY'S CORYTON REFINERY.

Mixing Vessels

Filling Machines

PIPEWORK FABRICATION & ERECTION

★ ★ ★

SIMMONS & HAWKER LTD

SOUTHDOWN WORKS · POINT PLEASANT

WANDSWORTH · LONDON · S·W·18

Telephone: VANdyke 4401/8 *Telegrams: Simmonic, Put, London*

Established 1825

BLUNDELL & CROMPTON LIMITED

Telephone:
East 3838 (3 lines) & 1408

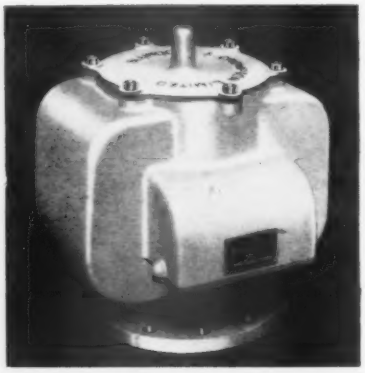
Telegrams:
Blundell, Phone, London

Sole Manufacturers:

BLUNDELL 'ATMOS' VALVES

"ATMOS VALVES"
are made in three types:

DEADWEIGHT
SPRING LOADED and
MERCURY SEAL



Deadweight Valve

FOR SAFE VENTILATION
of
OIL AND SPIRIT STORAGE
TANKS BOTH FOR LAND
AND MARINE
INSTALLATIONS

Further information:—

WEST INDIA DOCK ROAD - LONDON E.14

Marketing Code

Part 2 of Model Code of Safe Practice In the Petroleum Industry

Complete with 3-ring binder
to hold four parts of complete code

Price 26s. 0d. post free

(Supplied together with
Electrical Code at 38s. 6d.)

Obtainable from

The Institute of Petroleum
26 Portland Place, London, W.1

ASTM—IP PETROLEUM MEASUREMENT TABLES

Prepared jointly by the Institute of Petroleum and the American Society for Testing Materials, these standardized tables will be of incalculable benefit to all concerned with the measurement of petroleum products.

The Tables are available in three editions, viz:

American (U.S. units of measurement)	Price 63*s.* ($8.75)
British (Imperial units of measurement)	Price 50*s.* ($7.00)
Metric (Metric units of measurement)	Price 55*s.* ($7.70)

and are obtainable from

American Society for Testing Materials
1916 Race Street
Philadelphia, Pa., U.S.A.

Institute of Petroleum
26 Portland Place
London, W.1

A 3,000-gallon Mild Steel Tank mounted on Leyland Beaver chassis with Dyson undergear

A 3,600-gallon 6/compt. Mild Steel Petrol Tank on Foden chassis

Busy on the bulk transport job with petroleum spirit, fuel oils, lubricants . . busy all over the map for the leading names in the Oil Industry

Butterfield
ROAD TANKS

Butterfield Road Tanks are built to your specification in Mild Steel, Stainless Steel and Aluminium, insulated as required. Utmost stability is assured by Butterfield 'girder mounting' (if on the usual type of chassis) and for mounting on tractor/trailer equipment the streamlined effect and low centre of gravity can be maintained by 'stepping' the tank so as to avoid the articulating gear.

2,500-gallon Mild Steel Kerosene Tanks for export. Mounted on Leyland Beaver diesel-engined chassis

W. P. Butterfield Limited P.O. Box 38
Shipley, Yorkshire. Tel. 52244 (8 lines)
London: Africa House, Kingsway, W.C.2

For Oil Refinery & Chemical Plants

Type 7000

MILLENNIUM KEY

CAST STEEL FITTINGS

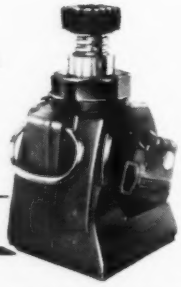
for strength and pressure tightness

Please write for bulletins which give full technical information on each type of fitting we can supply.

OUR OTHER PRODUCTS INCLUDE . . .

- ★ CARBON STEEL CASTINGS
- ★ ALLOY STEEL CASTINGS
- ★ HEAT RESISTING STEEL CASTINGS TO B.S. and A.S.T.M. SPECIFICATIONS
- ★ STAINLESS STEEL CASTINGS
- ★ MILLENITE IRON CASTINGS
- ★ S.G. IRON CASTINGS
- ★ *ALL CAN BE MACHINED IN OUR MODERN MACHINE SHOPS*

Also
HYDRAULIC & SCREW JACKS UP TO 20 TONS



Lake & Elliot Ltd.
BRAINTREE · ENGLAND

DRILLING-CONTRACTOR

exploration-exploitation
(any depth)

CRUDE OIL
GAS
COAL
ORE
and other MINERALS

write - wire - phone

DEUTSCHE SCHACHTBAU- UND TIEFBOHR GES.M.B.H.
LINGEN (EMS) GERMANY

for quality and precision

HY-CONTACT TOWER PACKINGS

HYDRONYL is supplying its HY-CONTACT Tower Packings for a great variety of absorption and distillation processes and the growing number of catalytic processes.

To cater for all requirements, HYDRONYL has added balls and saddles to its wide range of Lessing and Raschig ceramic, metal, glass, carbon, wire gauze and expanded metal rings.

A recent addition is SPRAYPAK for the manufacture and sale of which HYDRONYL has been licensed by the United Kingdom Atomic Energy Authority.

A notable example of the use of HY-CONTACT Lessing rings in a key position is the plutonium plant at the atomic factory at Windscale in which, with their aid, uranium and plutonium are separated from the nuclear fission products and from each other.

THE HYDRONYL SYNDICATE LTD, the pioneers of contact rings, have for over forty years maintained the lead in the field of tower packings.

We take pride in the service we are rendering to users by freely giving advice on the design of packed towers and on the type, size and material of HY-CONTACT packing elements.

The

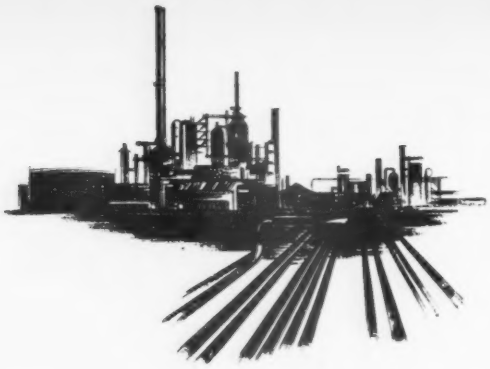
HYDRONYL SYNDICATE LTD

14 GLOUCESTER ROAD, LONDON, S.W.7

Telephone:
WEStern 4744

Telegrams:
Hydronyl, Kens, London

HY
CONTACT

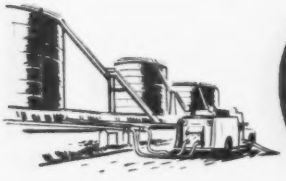


The world demands oil . . .

. . . the life-blood of modern civilisation. From this basic need has grown that vast world-wide organisation . . . the oil industry that keeps the wheels turning in a new world of revolutionary principles of mechanics. To-morrow demands a still greater production of oil and its by-products — bigger and better refinery plant — larger and ever extending oil tank farms.

. . . oil demands Pyrene TRADE MARK fire protection

With every step forward that oil production takes, new fire hazards of ever increasing proportions are created. It is here that "PYRENE" Fire Protection plays its vital role. We are proud of our long and extensive collaboration with the oil companies in the ceaseless task of ensuring maximum fire safety for installations which include some of the world's largest. There is no fire danger beyond the scope of



Pyrene TRADE MARK FIRE PROTECTION

an investment in peace of mind

We know that we can master known fire dangers in the oil industry — therefore our great experience and knowledge could be of real assistance to you in providing fire safety for your many fire risks. If you have an unsolved fire problem we would like to help you with it. In any case — why not let us co-operate? Write to Dept. I.P.R.

THE PYRENE COMPANY LIMITED

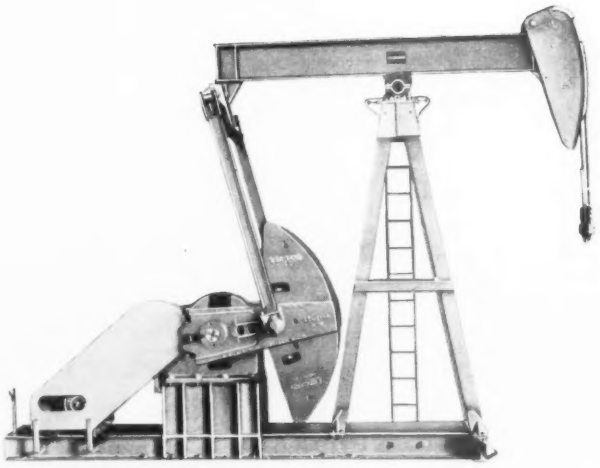
9 GROSVENOR GARDENS · LONDON, S.W.1 *Phone:* VICtoria 3401

Head Office & Works: BRENTFORD · MIDDLESEX *Canadian Plant:* TORONTO · CANADA

LEGRAND

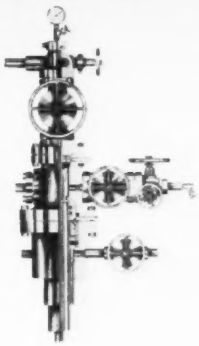
Oilfield Equipment.

Series L. Pumping Units.



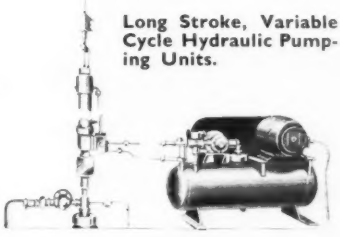
LEGRAND O·C·T

Casing and Tubing Heads, and Hangers.
Complete Christmas Trees.
Flow Controls and Chokes.
Misaligning Unions.
Adaptors and Flanges.
Christmas Tree Fittings.



LEGRAND *Carter*

Long Stroke, Variable Cycle Hydraulic Pumping Units.



LEGRAND Halliburton

Oil Well Cementing Equipment.
Guide Shoes, Float Shoes and Float Collars.
Measuring Devices.
Cementing Tools.

LEGRAND

LEGRAND SUTCLIFF & GELL LTD.

HORSTED AIRPORT, ROCHESTER, KENT, ENGLAND

We are represented in the following areas by agents who will be pleased to assist you:

CANADA:
LeGrand Ltd., 111—58th Avenue South West, Calgary, Alberta, Canada.

TRINIDAD:
Industrial Agencies Ltd., 14, High Street, San Fernando, Trinidad B.W.I.
Wilson & Johnstone Ltd., Port of Spain, Trinidad, B.W.I.

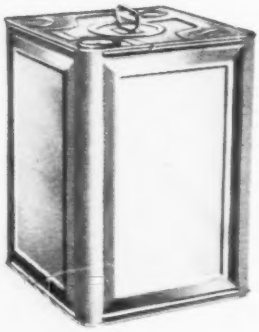
W. VENEZUELA:
A–Z Export, S. A, Apartado 304, Maracaibo, W. Venezuela.

E. VENEZUELA:
A–Z Export, S. A., Apartado 4026, Puerto La Cruz, E. Venezuela.

WHETHER YOU MAKE CANS LIKE

THIS OR

THIS



IN FACT—ANY SHAPE . . .

There is BLISS can making equipment for higher production at less cost —

Send samples together with output figures and we shall be pleased to put forward our recommendations.

E. W. BLISS (ENGLAND) LTD

CITY ROAD **DERBY**

Telephone: DERBY 45801

London Office:

2/3 THE SANCTUARY, WESTMINSTER, S.W.1

Telephone: ABBEY 3651

REMEMBER . . .

IT'S BLISS ***FOR CAN MACHINERY***

When?

Who knows what subtle power will drive our airliners and space ships of the future. Science will continue to make many wonderful discoveries within the next century, for man is still on the threshold of harnessing nature's forces — but meantime, industry's increasing demands on our diminishing supplies of coal and oil makes fuel economy a vital necessity. In the processing of oil to power our aircraft and vehicles, and provide us with many by-products in this 20th century and the future, Kenyon planned Heat Insulation will play its part.

Kenyon *Planned* **HEAT INSULATION**

WILLIAM KENYON & SONS LIMITED · DUKINFIELD · CHESHIRE

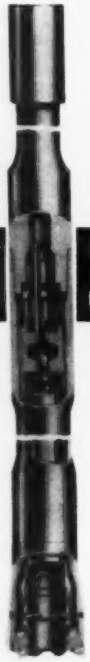
KH 175

PROGRESSIVE OIL OPERATORS THE WORLD OVER

know, from their own experience, that Reed products always meet the highest standards of advanced design and quality control.

REED ROCK BITS

REED TOOL JOINTS



REED CORE DRILLS

Reed's record of reliability over more than a third of a century is your assurance that you can always depend on Reed products.

Write for catalog describing Reed's full line of bits, tool joints, core drills, and drill collars.

REED ROLLER BIT COMPANY

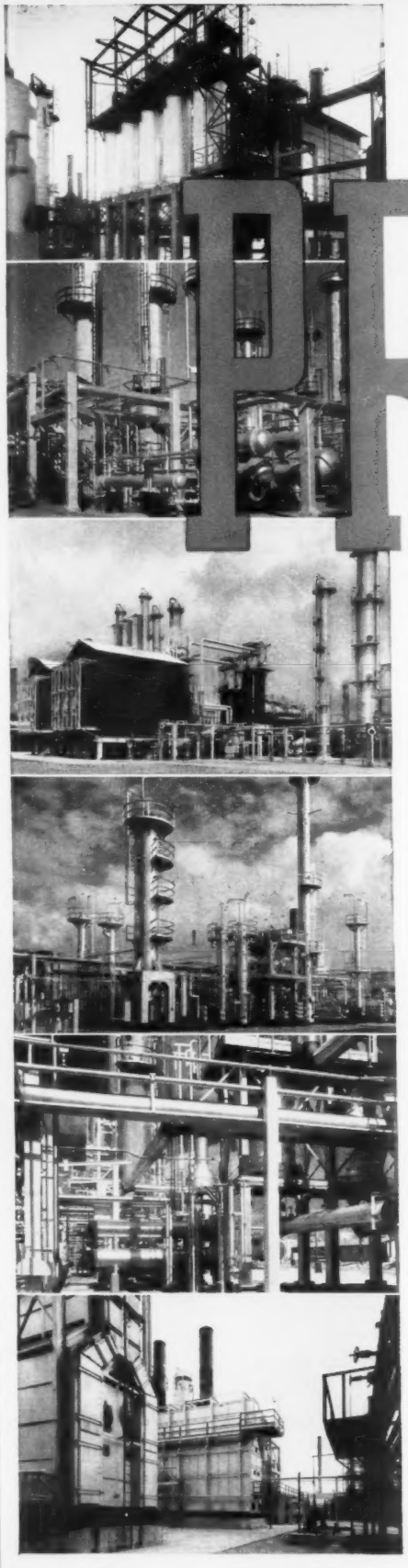
MAIN OFFICE AND FACTORY — P. O. BOX 2119, HOUSTON 1, TEXAS, U.S.A.

EXPORT OFFICE
International Bldg., New York 20, N. Y.

ENGLAND
Moorgate Hall, Moorgate, London, E.C. 2

THE MARK OF QUALITY

5453



CONSTRUCTION BY

PROCON

A company is as young as the unbounded energies and ambitions of the men who comprise its personnel . . . as old as their years of experience . . . and as competent as the sum of their proved capabilities.

Within the Procon organization, these factors add up to a substantial and impressive figure . . . a combination of assets that has enabled us to handle successfully a great many construction jobs of considerable magnitude and complexity . . . to do them efficiently and economically . . . with completions on schedule.

Procon is a well-rounded organization, fully equipped to handle all construction jobs in any part of the world. Procon service is complete . . . designing, engineering, procurement, construction. Procon clients are leaders of industry whose satisfaction is best expressed by the continuance of their patronage.

When your plans for the future include a construction project, talk it over with a Procon engineer. We believe you'll find it time well spent.

PROCON ®

PROCON (*Great Britain*) LIMITED

PROCESS CONSTRUCTION

112 STRAND, LONDON, W. C. 2

PROCON (CANADA) LIMITED—40 ADVANCE ROAD, TORONTO 18, ONTARIO

PROCON INCORPORATED—1111 MT. PROSPECT ROAD, DES PLAINES, ILL., U. S. A.

At Sui in Pakistan there is abundant natural gas. Away in Karachi there are industries which could use it for fuel. Engineers have contracted to connect the two—by 350 miles of steel pipeline carrying millions of cubic feet of gas per day.

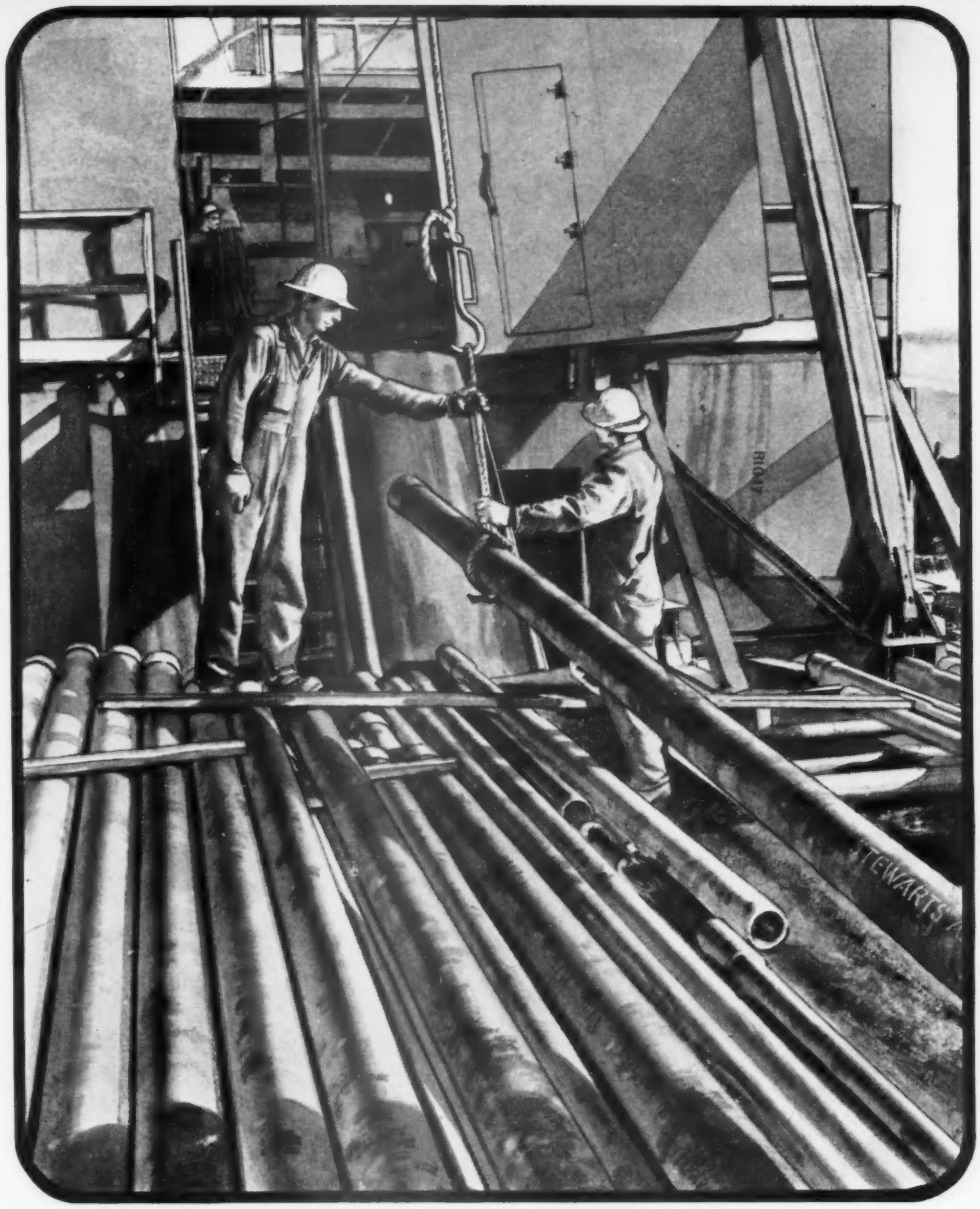
To protect this pipeline from corrosion ten million square feet of Fibreglass tissue pipewrap will be used in field application. The contract for the whole of this pipewrap has been secured by Fibreglass Limited, in open competition. In fact Fibreglass will be used in more ways than one, for the outer wrap of 'Thermoglas', to be supplied by D. Anderson & Son Ltd., is also based on Fibreglass tissue.

Yet this pipeline is only one of many in all parts of the world which rely on Fibreglass for protection against corrosion — and the protection of pipelines is only one among the many ways in which Fibreglass contributes to the efficiency of modern industry.

FIBREGLASS TRADE MARK

FIBREGLASS LIMITED, RAVENHEAD, ST. HELENS, LANCS. (St. Helens 4224)

FACTORIES AT ST. HELENS, LANCS. AND POSSILPARK, GLASGOW



THE STEEL TUBE AGE

S & L steel casing,
9⅝-inch outside diameter,
being prepared for stringing at a location
of Imperial Oilfields Ltd., Alberta, Canada

STEWARTS AND LLOYDS LIMITED

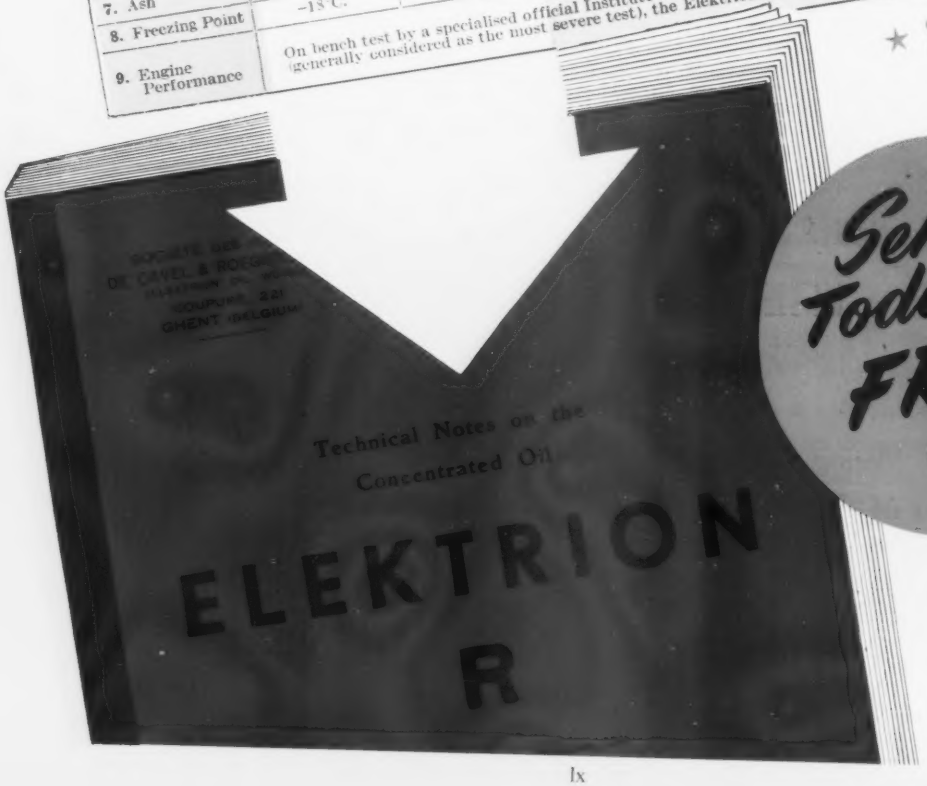
GLASGOW · BIRMINGHAM · LONDON

The largest manufacturers S&L *of steel tubes in Europe*

FACTS & FIGURES *Scientifically established!*

	A★ SAE 30 Oil **BEFORE** Elektrionisation	Same SAE 30 Oil **AFTER** Elektrionisation		
1. Viscosity at :			More fluid when cold	Improved cold starting (economical use of battery)
10°F. ..	5200 cs.	2500 cs.		Better lubrication of cold engine
32°F. ..	1400 cs.	850 cs.		Quicker "Speed-up" of cold engine
70°F. ..	240 cs.	201 cs.	More viscous when hot	Stronger Oil Film (less wear)
100°F. ..	89 cs.	82 cs.		Reduced Oil Consumption
140°F. ..	32.5 cs.	32.5 cs.		Improved compression
200°F. ..	11.1 cs.	12.6 cs.		
210°F. ..	9.9 cs.	11.2 cs.		
300°F. ..	3.7 cs.	4.4 cs.		
2. Viscosity Index (V.I.)	97	123	Optimum V.I. obtained without addition of rubbery V.I. improvers lacking oiliness	As fluid when cold as an SAE 10 and as viscous when hot as an SAE 40 Same oil winter and summer
3. Oiliness :— Coefficient of Static Friction				
at 10°C. ..	0.190	0.134	A record in oiliness (Oilier than Castor Oil)	Reduced Friction and reduced Fuel consumption
at 80°C. ..	0.155	0.080		Suppression of chatter (slip-stick phenomenon)
	much chatter	no chatter		Smoother polish of friction surfaces
				Longer engine life
4. Heating Test at 150°C. in thermostatic air bath	Deposit in 120 hr.	No Deposit after 450 hr.	Four times more resistant to formation of oxidation deposits	Engine is cleaner (less stripping and overhauling)
5. Conradson Carbon	0.3%	0.1%	Three times less coke	Permits increased mileage between oil drainings
6. Dispersing Power :— Time for flocculation of carbon black	Less than 72 hr.	None after several years	Maximum Detergency (obtained without addition of organo-metallic dopes which form ash and increase wear)	Longer life for filters No unpleasant smell Does not attack copper Mixes with other oils
7. Ash ..	0%	0%		
8. Freezing Point	-18°C.	-28°C.	The lowest freezing point	The same oil for all cimates
9. Engine Performance	On bench test by a specialised official Institute with a Renault 4 h.p. engine, developing 15 b.h.p. for 50 hr. (generally considered as the most severe test), the Elektrionised oil surpassed all others.			

★ Oil typical of well known International brands.



Send Today for FREE copy

SOCIÉTÉ DES HUILES
DE CAVEL &
ROEGIERS S.A.
COUPURE 221
GHENT, BELGIUM

Round the World with BADGER . . .

In all four corners of the world Badger-built plants are turning out quality products for the Petroleum, Chemical, and Petro-chemical industries. Badger, with its completely integrated specialist organization, offers a step by step service from the basic design to the finished plant based on a sure foundation of knowledge and experience.

E. B. BADGER & SONS LIMITED

99, ALDWYCH, LONDON, W.C.2

Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

Affiliated with STONE & WEBSTER ENGINEERING CORPORATION, Badger Process Division, U.S.A.

METAL CONTAINERS

weather the weather!

METAL CONTAINERS LTD., 17 WATERLOO PLACE, PALL MALL, LONDON

WORKS: ELLESMERE PORT & RENFREW

ASSOCIATED COMPANIES OVERSEAS

M-W.116